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PART III—ABSTRACTS

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46th INDIAN SCIENCE CONGRESS, DELHI, 1959

SECTION OF MATHEMATICS

President : Prof. M. Ray, D.Sc., F.N.I.

Abstracts

THEORY OF FUNCTIONS

1. On the Absolute Summability Factors for Infinite series

Ganesh Datta Dikshit, Allahabad

The object of this paper is to prove the following :

Theorem 1. *Let* Σu_n *be a given series and* S_n^α *denote its n-th Cesàro mean of order* α, $(\alpha \geqslant 0)$. *If*

$$\sum_{m=1}^{n} |S_m^\alpha - S_{m-1}^\alpha| = O\{\mu_n\},$$

where $\{\mu_n\}$ *is a, positive monotonic increasing sequence and tends to infinity with n, then* $\Sigma a_n \lambda_n$ *is summable* $|C, \alpha|$ *where* $\{\lambda_n\}$ *and* $\{\mu_n\}$ *are such that*

(i) $\lambda_n \mu_n \to 0$, *as* $n \to \infty$,

(ii) $|\Delta\lambda_n|$ *is monotonic non-increasing*

and (iii) $\Sigma n^h |\Delta^{h+1} \lambda_n| \mu_n < \infty$,

where h is the least integer not less than α.

The above theorem is an extension of a theorem due to Sunouchi (Kodai, Math. Semi. Report, 1954, 59-62). By the help of this theorem we also extend some theorems on absolutely summable Fourier series, recently proved by Prasad and Bhatt (Duke Math. Jour., 24, 1957, 103-20). The following theorem is one of the typical results given by the author in this direction.

Theorem 2. *If* $\Phi_\alpha(t)$ $(\alpha > 0)$ *is of bounded variation in the interval* $(0, \pi)$ *and the sequence* $\{\lambda_n\}$ *is such that*

(i) $\log_n \lambda_n \to 0$, *as* $n \to \infty$,

(ii) $|\Delta\lambda_n|$ *is monotonic non-increasing*

and (iii) $n^h |\Delta^{h+1}\lambda_n| \log n < \infty$,

where h is the least integer not less than α, *then the series* $\Sigma A_n(t)\lambda_n$, *at* $t = x$, *is summable* $|C, \alpha|$.

2. A Summability Factor Theorem on Second Theorem of consistency for Absolute Riesz Summability

Ganesh Datta Dikshit, Allahabad

1. *Definition :* Let $\{\lambda_n\}$ be a positive monotonic increasing sequence tending to infinity as n tends to infinity, and let Σa_n be a given infinite series. Let us write

$$R_\lambda(\omega) = R_\lambda^0(\omega) = \sum_{\lambda_n < \omega} a_n\,;\; R_\lambda^k(\omega) = \sum_{\lambda_n < \omega} \left(1 - \frac{\lambda_n}{\omega}\right) a_n \;(k > 0).$$

The series Σa_n is said to be summable $|R, \lambda, k|$, $k \geqslant 0$, if $R_\lambda^k \, \varepsilon BV(h, \infty)$, where h is some finite positive number.

2. The object of this paper is to give the following theorem on summability factors concerning the second theorem of consistency for absolutely summable series by typical means.

Theorem : *For a non-negative integral* κ *let* $\phi(\omega)$ *and* $\psi(\omega)$ *be the* κ*-th indefinite integral for* $\omega \geqslant 0$, *and* $\phi(\omega)$ *in addition be a non-negative unbounded increasing function of* ω, *tending to infinity with* ω. *If a positive function* $\gamma(\omega)$ *exists such that*

$$\text{(i)} \qquad \frac{\gamma(\omega)}{\omega} \, \varepsilon \, BV(h, \infty),$$

$$\text{(ii)} \qquad \omega^n \psi^{(n)}(\omega) = O\left[\left\{\frac{\gamma(\omega)}{\omega}\right\}^{\kappa - n}\right] \; (n = 0, 1 \ldots, \kappa \, ; \, \omega \geqslant h)$$

$$\text{and (iii)} \qquad \{\gamma(\omega)\}^n \phi^{(n)}(\omega) = O\,\{\phi(\omega)\} \; (n = 1, 2, \ldots \kappa \, ; \, \omega > h),$$

where h *is a finite positive number, then* $\Sigma a_n \psi(\lambda_n)$ *will be summable* $|R, \phi(\lambda)\, \kappa)$ *if* Σa_n *is summable* $|R, \lambda, \kappa|$.

It can be remarked that the case $\phi(\omega) = e^\omega$, $\psi(\omega) = \omega^\kappa$, $\gamma(\omega) = 1$, of the above theorem gives a result due to Tatchell (J.L.M.S., 29, 1954, 49-59). Also if we take $\varphi(\omega) = 1$ and $\gamma(\omega) = \omega$, then the theorem reduces to the second theorem of consistency as given by Pati (Q.J.M.(Oxford), (2), 5, 1954, 161-68) and Guha (J.L.M.S., 31, 1956, 300–11). The theorem on convergence factors for absolutely summable series as given by Guha (J.L.M.S., 31, 1956, 311-19) can also be deduced from our theorem.

3. An Aspect of Local Property of Absolute Nörlund Summability of a Fourier Series

SHRI NIVAS BHATT, Allahabad

Let $f(t)$ be integrable (L) over $(-\pi, \pi)$, and periodic with period 2π, and let its Fourier series be given by

$$\tfrac{1}{2}a_0 + \Sigma(a_n \cos nt + b_n \sin nt) = \Sigma A_n(t).$$

In 1939 Bosanquet and Kestelman proved that the summability $|C, \delta|$, $0 < \delta \leqslant 1$ of a Lebesgue Fourier series is not a local property of the generating function. Since the summability $|N, p_n|$ when

$$p_n = \binom{n + \alpha - 1}{\alpha - 1}, \; 0 < \alpha < 1$$

is the same as summability $|C, \alpha|$, hence it follows that the absolute Nörlund summability at a point of a Fourier series may not be ensured by a local property.

The object of this paper is to study the conditions under which the summability $|N, P_n|$ of a Fourier series at a point can be ensured by a local condition. In fact, we prove that if $\Sigma |A_n(x)| / P_n$ *is convergent then the summability* $|N, p_n|$ *of a Fourier series at a point becomes a local property.* This result contains as a particular case a previous result of Zurkat and Peyerimhoff (*Math. Zeitschrift*, 64, 1954, 151–158) on the summability $|C, \alpha|$, $0 < \alpha < 1$.

4. On the Absolute Summability of a Fourier Series

SHRI NIVAS BHATT, Allahabad

1. It was shown by Whittaker with the help of an example, suggested by Littlewood, that a Fourier series may converge at a point without being summable $|A|$ at that point. On the other hand Prasad constructed an example of a Fourier series to show that a series can be summable $|A|$ at a point without being convergent at that point. Since negative order summability includes convergence, it follows from Prasad's example that a Fourier series can be summable $|A|$ without being summable by any negative order.

It can be sown that the series suggested by Littlewood is not only convergent but is also summable $(C, -1+\delta)$, $\delta > 0$. Now since, absolute Cesàro summability implies absolute Abel summability, it follows that the summability $(C, -1+\delta)$ does not necessitate summability $|C, K|$. It may thus be interesting to investigate conditions under which both absolute summability and negative order summability of a series can be effected.

2. The following theorem has been proved :

Theorem. *If, there is a* $\Delta > 1$, *such that*

$$\int \varphi(u)du = 0\left(t^{\Delta + 1 - \frac{1}{\Delta}}\right),$$

at $t \to 0$, *and*

$$\int^{t} |d\left\{u^{\Delta + \frac{1}{\Delta} - 1} \varphi(u)\right\} = O(t)$$

$0 \leqslant t \leqslant \pi$ *the Fourier series of* $f(t)$ *at*

$t = x$ *is summable* $|C, \beta|$ *where* $\beta > 1 - \frac{1}{\Delta}$

Bhatt (*Proc. National Institute of Sciences of India*. **22.** *A*, 1956, 298-304) has proved that under the conditions of the above theorem the Fourier series is summable $\left(C, -\frac{1}{\Delta}\right)$ *to* S, at *the point* $t = x$.

5. On the Absolute Convergence of a Fourier Series with Gaps

SYED MOHAMMAD MAZHAR, Allahabad

1.1. A function $\phi(x)$ defined in an interval (a, b) is said to be of bounded r-th variation if $x_0, x_1, x_2, \ldots x_n$, are arbitrary values in arithmetical progression such that

$$a = x_0 < x_1 < x_2 < \ldots < x_n = b.$$

then

$$\sum_{i=0}^{n-\gamma} |\Delta r \phi(x_1)| \leqslant M$$

where

$$\Delta^{q}\phi(x_i) = \Delta^{q-1}\phi(x_{i+1}) - \Lambda^{q-1}\phi(x_i).$$

$$\Delta\,\phi(x_i) = \phi(x_{i+1}) - \phi(x_i).$$

1.2. Let $f(x)\varepsilon L(-\pi, \pi)$ with period 2π and let its Fourier constants a_n, b_n vanish except for a sequence $n = n_k$ with

$$\text{Min}\{(n_k - n_{k-2}), (n_{k+8} - n_k)\} = N_k.$$

2.1. Noble (Mathematische Annalen, 128, 1954, 55-62) has proved the following theorem on the absolute convergence of a Fourier series satisfying a certain gap condition.

Theorem. *Suppose that* $\underset{k\to\infty}{\text{at}} \dfrac{N_k}{\log n_k} = \infty$ *and that* $f(x)$ *is of bounded variation and satisfies a Lipschitz condition of order* α *where* $0 < \alpha < 1$ *in some interval* $|x - x_0| \leqslant \delta$

then $$\Sigma(|a_n| + |b_n|) < \infty .$$

The author has generalized the above theorem by replacing the condition of bounded variation by a less stringent condition of bounded r-th variation.

6. Some Converse Theorems on the Absolute Cesàro Summability of a Series Related to Fourier Series

(Kumari) Sulaxana Kumari, Allahabad

Suppose that $f(\theta)$ is integrable (L) over $(-\pi, \pi)$ and periodic outside this range with period 2π. Let the Fourier series of $f(\theta)$ be

$$f(\theta) \sim \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos n\theta + b_n \sin n\theta) = \frac{A_0}{2} + \sum_{n=1}^{\infty} A_n(\theta).$$

Let

$$\phi(t) = \tfrac{1}{2}\{f(x+t) + f(x-t)\},$$

$$\phi_\alpha(t) = \frac{\alpha}{t^\alpha}\int_0^t (t-u)^{\alpha-1}\phi(u)du, \ \alpha > 0.$$

Following theorems have been proved :

Theorem 1. *If, for* $\alpha \geqslant 0$, $-1 < \rho < 1$, $\alpha - \rho \geqslant 0$, *the series* $\Sigma n^\rho A_n(\theta)$, *at* $\theta = x$, *is summable* $|C, \alpha|$, *then* $\phi_\beta(t)$ *is of bounded variation in* $(0, \pi)$, *for every* $\beta > \alpha + 1 - \rho$.

Theorem 2. *If, for* $\alpha \geqslant 0$, $-1 < \rho < 1$, $\alpha - \rho > 0$, *the series* $\Sigma\, n^\rho\, A_n(\theta)$. $(\log n)^{-1-\varepsilon}$, $\delta > 0$, *at* $\theta = x$, *is summable* $|C, \alpha|$, *then* $\phi_\beta(t)$ *is of bounded variation in* $(0, \pi)$, *for* $\beta = \alpha + 1 - \rho$.

The particular case $\rho = 0$ of Theorem 1 is a well known result due to Bosanquet (*Proc. London Math. Soc.*, 41, 1936, 516–528).

7. On the Non-local Property of the Summability $| R, \log n, \frac{1}{p} |$ of the Fourier Series of the Class L^p

(Kumari) Sulaxana Kumari, Allahabad

Let $\mathcal{S}[f]$ denote the Fourier series of $f(x)$ which is assumed to be periodic with period 2π and belonging to the class L^p, where $1 < p \leqslant 2$.

It has been proved in this paper that the summability $|R, \log n, 1/p|$ of $\mathcal{S}[f]$ is not a local property, the result for the non-local nature of the summability $|C, 1/p|$ being due to Albert Foá (Boll. Un. Mat. Ital. (2), 2 (1940), 325-332).

8. A Note on the Concept of Strong Summability

(Kumari) Pramila Srivastava, Allahabad.

1. In this paper the relationships between the various definitions of strong summability methods, given so far, have been discussed and thereby has been evolved a general principle according to which strong summability corresponding to any T-process and to any ϕ-process of summation may be formulated.

2. Here $T-\Sigma a_n$, $[T] . \Sigma a_n$ and $|T| - \Sigma a_n$ denote respectively summability T of Σa_n, strong summability T of Σa_n and absolute summability T of Σa_n. Similar meaning is attached to $\phi - \Sigma a_n$, $[\phi] - \Sigma a_n$ and $|\phi| - \Sigma a_n$. With these notations the following theorem has been proved.

Theorem 1. *The inclusion relations*

$$|T| - \Sigma a_n \subset [T] - \Sigma a_n \subset T - \Sigma a_n$$

and

$$|\phi| - \Sigma a_n \subset [\phi] - \Sigma a_n \subset \phi . \Sigma a_n$$

hold.

3. Finally the relationship between summability $|A|_k$ introduced by Flett (Proc. London Math. Soc. (3) 1957) and strong Abel summability with index k, i.e. summability $[A, k\}$, (Harrington and Hyslop; Proc. Edinburgh Math. Soc., 1953) has been obtained in the following theorem.

Theorem 2. *If* Σa_n *is summable* $|A|_k$, *then it is also summable* $[A, k]$.

9. On the Absolute Summability Factors of Fourier Series

T. Pati and S. R. Sinha, Allahabad.

1. Let $f(t)$ be a periodic function with period 2π and integrable (L) over $(-\pi, \pi)$. Without any loss of generality we may assume the constant term in the Fourier series of $f(t)$ to be zero, so that

$$\int_{-\pi}^{\pi} f(t)dt = 0$$

and

$$f(t) \sim \Sigma (a_n \cos nt + b_n \sin nt) = \Sigma c_n (t).$$

We use the following notations

$$\phi(t) = (1/2)[f(x+t) + f(x-t) - 2f(x)]$$

$$\Phi_\alpha(t) = (1/\Gamma\alpha)\int_0^t (t-u)^{\alpha-1}\phi(u)du \qquad (\alpha > 0),$$

$$\Phi_0(t) = \phi(t),$$

$$\Phi_\alpha(t) = \Gamma(\alpha+1)\, t^{-\alpha}\, \Phi_\alpha(t) \qquad (\alpha \geqslant 0).$$

A sequence $\{\lambda_n\}$ is said to be convex if

$$\Delta^2 \lambda_n \geqslant 0.$$

We shall say that the sequence $\{\lambda_n\}$ is hyper-convex of order h, if

$$\Delta^{h+2}\lambda_n \geqslant 0, \quad (h = 0, 1, \ldots).$$

By definition, hyper-convexity of order zero is the same as convexity.

2. In 1954, one of the authors generalized all the existing theorems in this direction by proving the following theorem [Pati, Duke Math. Jour., 21, 1954, 271-284] :

If $\{\lambda_n\}$ *is a convex sequence such that* $\Sigma n^{-1}\lambda_n$ *is convergent and*

$$\int_0^t |\phi(u)|\ du = 0(t),\ t \to 0, \qquad \ldots (2.1)$$

then $\Sigma\lambda_n c_n(x)$ *is summable* $|C, \alpha|$, *for every* $\alpha > 1$.

3. The object of the present paper is to generalize the above theorem by replacing the condition (2.1) by the less stringent condition

$$\int_0^t |\phi_h(u)|\, du = 0(t), \quad t \to 0, \qquad \ldots (3.1)$$

and to establish the following theorem.

Theorem. *Let* h *be a positive integer* >0 *and let* $\{\lambda_n\}$ *be a monotonic non-increasing sequence when* $h = 0$, *and a hyperconvex sequence of order* $(h-1)$, *when* $h \geqslant 1$, *such that*

$$\text{(i)} \quad \Sigma n^{-1}\lambda_n < \infty \text{ and}$$

$$\text{(ii)} \quad \Sigma n^h \Delta^{h+1}\lambda_n < \infty. \qquad (3.2)$$

Then if (3.1) *holds,* $\Sigma\lambda_n c_n(x)$ *is summable* $|C, h+1+\delta|$ *for every* $\delta > 0$.

10. Construction of a class of steadily increasing continuous functions which are not absolutely continuous

P. L. Ganguli, Calcutta.

Starting with a Gilman's non-dense perfect set of measure zero we have constructed a class of steadily increasing continuous functions which are not absolutely continuous.

11. Note on Holder and Riesz Methods of Negative Order

S. K. Basu, Calcutta.

Let H_n^{α} denote the Hölder mean of order α for a series $\sum_{n=0}^{\infty} a_n$ and $A(x)$ its Abel mean. Let $\sum_{n=0}^{\infty} a_n x^n$ converge for $0 < x < \delta$, where δ is sufficiently small and let $\sum_{n=0}^{\infty} a_n x^n$

generate an analytic functions $A^*(x)$. We define the Riesz mean by the formula

$$\beta^*(w) = \sum_{r=0}^{[\omega]-1} a_r \left(1 - \frac{r}{\omega}\right)^x, \quad 0 \leqslant \omega < \infty.$$

Then we have the following theorems :

Theorem 1. *For* $-1 < a \leqslant 1$, $H_n^{\alpha} \rightarrow A(x)$.

Theorem 2. *For* $-1 < n < 0$, $\beta^k(\omega) \rightarrow A^*(x)$.

[Here $H_n^{\alpha} \rightarrow A(x)$ denotes the fact that $H_n^{\alpha} \rightarrow l(-\infty \leqslant l \leqslant \infty)$ implies $A(n) \rightarrow l$]

GEOMETRY

12. On $(n+1)$ Intersecting Hyperspheres in n-space

Sahib Ram Mandan, Kharagpur.

'On four intersecting spheres' (in press) in a solid makes the author think of an analogous picture in higher spaces too and thus arises the present paper. We start with a four dimensional space and develop the relative ideas 'On five intersecting hyperspheres' therein suggesting the respective results in an n-dimensional space, deduced mostly by the method of induction from the work below. Some interesting ones arrived at here are as follows:

The hyperplanes of perspectivity, of the 2^n pairs of complementary simplexes of intersection, of $(n+1)$ intersecting hyperspheres in an n-space, are the radical hyperplanes of the corresponding pairs of complementary hyperspheres of intersection, coincide with the hyperplanes of similitude of the associated set of $(n+1)$ hyperspheres, and form an S-configuration such that its diagonal simplex is the radical one of the given hyperspheres or that is the same as the central simplex of the associated set of hyperspheres, and the pairs of its opposite vertices coincide with their centres of similitude and are conjugate for their common orthogonal hypersphere.

The 2^n centres of similitude (other than the orthogonal centre of the given $(n+1)$ intersecting hyperspheres) of the pairs of complementary hyperspheres of intersection of them constitute the vertices of the polar reciprocal of the said S-configuration w.r.t. their orthogonal hypersphere such that the S-configuration is inscribed in its reciprocal. The perpendicular from the orthogonal centre of the given $(n+1)$ hyperspheres upon the Newtonian hyperplane of their associated set passes through the circumcentre of their radical simplex. Each hypersphere of anti-similitude of the associated set of $(n+1)$ hyperspheres taken in pairs is orthogonal to 2^n hyperspheres of intersection and to $(n-1)$ of the given $(n+1)$ hyperspheres.

In the end corresponding results for $(n+1)$ mutually orthogonal and real hyperspheres are deduced. Finally umbilical projection is suggested as a process to get these results rather quickly.

13. Generation of Rosenhain Tetrads and Desmic Triads of Tetrahedra

Sahib Ram Mandan, Kharagpur.

Inspired by the interesting Mathematical Note, 'On the generation of sets of four tetrahedra of which any two are mutually inscribed', of Hanumanta and Baker in

Proc. Camb. Phil. Soc. XX, 1920-21, 155-57, we are able to derive here a pair of conjugate desmic systems of points from a tetrad of Moebius Tetrahedra. The results of the two Papers 'Moebius Tetrads' Amer. Math. Monthly, LXIV, 7(1957), 471-78, LXV, 4(1958), 247-51 and a third, 'Tetrads of Moebius Tetrahedra' (in press) are amply used here.

14. Altitudes of a General Simplex in 4-space

Sahib Ram Mandan, Kharagpur.

This paper is an addendum to the one, 'Altitudes of a simplex in four dimensional space' (in press, abstract published in the proceedings of the 45th session of the Indian Science Congress Association held at Madras in January 1958). It is proved here that *altitudes of a general simplex form a set of 5 associated lines.* A few particulars of special cases are also considered.

DIFFERENTIAL GEOMETRY

15. On a Type of Riemannian Space of Class One

M. C. Chaki. Calcutta.

Ruse and Walker introduced the recurrent spaces which satisfy a curvature relation of the form $R_{ijkl,p} = \lambda_p R_{ijkl}$ where λ_p is a non-zero vector and comma denotes covariant differentiation. In a recent paper A. Lichnerowicz considered Riemannian spaces for which the curvature tensor satisfies a relation of the form $R_{ijkl,mn} = a_{mn} . R_{ijkl}$ where a_{mn} is a non-zero tensor. He called such a space a recurrent space of order two. The present paper deals with a type of Rimannian space V_n $(n > 2)$ of class one for which the rank of the matrix of the second fundamental tensor is supposed to be n. It has been proved that such spaces can not be recurrent. Further, the question whether they can be recurrent spaces of order two has been discussed and a necessary and sufficient condition for such spaces to be symmetric in the sense of Cartan has been obtained.

16. Motions and Lie Derivatives in Bundles of Vectoroids

Mrs. N. Prakash add Ram Behari, Delhi.

In this paper we have obtained the Lie derivatives of Vectoroids and tensoroids as based on the point transformation $y^i = x^i + \xi^{Ai} \delta t$ and have shown that Lie derivatives for Vectors can be deduced from them as natural corollaries.

It has been assumed that the point transformation given above defines a motion in base space in the classical sense.

MODERN ALGEBRA

17. Characters of Space Groups

T. Venkatarayudu and I. V. V. Raghavacharyulu, Waltair.

Tisza (Zeit. fuer Phy. 82, 48, 1933) obtained the characters of all point groups and they have been extensively used in the study of molecular vibrations. Similar studies can be extended to the case of crystals but the groups required in this case are space groups and the corresponding characters are not available. Winston and Halford (J. Chem. Phy. 17, 607, 1949) gave a formula for the characters of space groups which is valid only for a few point space groups. In this paper a general formula applicable to all space groups is given.

The representations of a space group could be obtained from those of its subgroups $G(k)$ consisting of the elements of G which transform a wave vector k of the reciprocal space of G into itself or into an equivalent one. Using a left coset decomposition of G with respect to $G(k)$, we set up a monomial representation M of G. By substituting for the elements of $G(k)$ in M, matrices corresponding to these elements in a nonspurious representation of $G(k)$ we obtain a matrix representation of G. The representations of G obtained in this manner are easily proved to be non-equivalent and complete. The characters of G are deduced from these representations.

18. On Matrices over a Lattice

H. M. Sengupta, Calcutta.

In this article the author considers the set of $n \times n$ matrices over a lattice and defines union, meet and inclusion among elements of the matrices in such a manner that the matrices again are made into a lattice having properties similar to those of the fundamental lattice over which the matrices are defined.

FLUID DYNAMICS

19. Boundary Layer Thickness

B. R. Seth, Kharagpur.

In the recent IUTAM symposium on 'Boundary Layer Research', B. R. Seth, Proc. IUTAM symposium on Boundary Layer Research, Freiburg, Springer-Verlag, 1958, it was made out that boundary layer thickness should be of the order $R^{-k/(2+\lambda)}$, $0 < k < 1$, $\lambda > 0$, instead of the classical value $R^{-1/2}$. This was done by a synthetic method, taking particular cases of the flat plate, a circular cylinder and a sphere. This formula is now shown to be generally valid and a method is indicated for calculating the values of λ and k from the vorticity present near the boundary and that allowable outside the layer.

20. Steady Flow of Linear Fluent Materials Past a Fixed Sphere

P. D. S. Verma, Kharagpur.

The problem of steady flow past a fixed sphere has been solved for incompressible linear fluent materials recently introduced by Walter Noll as a special type of hygrosteric materials. It is found that in case the viscosity constant vanishes, the material behaves like an ordinary perfect liquid.

21. Resistance in Potential Flow of Real Fluids : Prolate and Oblate Spheroids

N. L. Ghosh and H. K. Chatterjee, Calcutta.

This paper seeks to calculate the resistance in potential flow due to a uniform motion of translation of a prolate or an oblate spheroid in a real fluid.

In the special case when the eccentricity tends to zero, the results agree with that of a sphere for the same problem as worked out earlier by the senior author; it also contains a clarification of the point of view adopted by him in the earlier work referred to.

22. Initial Motion of a Viscous Incompressible Fluid in an Elliptic Pipe and an Analogous Problem in Heat Conduction

O. P. BHUTANI, Kharagpur.

By means of Laplace Transform the Navier-Stokes equations for the commencement of flow of viscous incompressible fluid have been transformed to a standard Mathieu Equation. The contour integral involving the Mathieu Functions has been evaluated completely. The solution tends to the steady state as t tends to ∞. This solution of viscous flow problem can be used in the problem of flow of heat inside a long elliptic cylinder with zero initial temperature and with heat production for $t > 0$ at the constant rate, the surface being kept at zero temperature.

23. Revolving Flow of an Incompressible Fluid Past a Porous Flat Plate

R. S. NANDA, Kharagpur.

The boundary layer equations for the flow of an incompressible fluid over a porous flat plate, when the liquid at infinity rotates with uniform angular velocity about an axis perpendicular to the plate, are reduced with the help of Kármán's substitutions to a set of ordinary non-linear differential equations for the velocity functions. It is found that the effect of suction depends on a non-dimensional parameter 'a' given by $W_0 = a\sqrt{\nu\omega}$, where ω is the uniform angular velocity of the flow at infinity, $-W_0$ is the uniform velocity of suction through the plate and ν is the kinematic viscosity.

The momentum thickness and the displacement thickness corresponding to the tangential velocity are computed for different values of the suction parameter and the results have been presented in a tabular form. It is shown that the momentum thickness and the displacement thickness decrease as the suction increases.

24. Estimation of the Critical Velocity for the Propagation of the Disturbance Up-Stream in Shock Wave Boundary Layer Interaction

AJIT KUMAR ROY, Bangalore.

Lighthill (1953) in his mathematical treatment of the problems in Weak Shock Boundary Layer Interactions (i.e., flows without separation) assumed a very thin viscous layer adjacent to the boundary where the disturbances are effected by viscosity and the mach numbers remain small enough for compressibility to be neglected. On similarity considerations, Roy (1958) has calculated the thickness of this viscous sub-layer of Lighthill both in weak and strong interactions of the shock waves with the boundary layers (either laminar or turbulent) (i.e., flows without or with separation.)

In the present paper, defining a uniform flow with the critical velocity for which the pressure change along a flat plate, due to shock waves incident on it, is equal to the dynamic pressure of the corresponding flow, it is found that the mach number of the flow in this sub-layer lies between 0.15 and 0.6. Further, applying this result, the earlier theory of Tsien and Finston (1949) where the mach number of this sub-layer (sub-sonic layer) could not be specified, has been improved.

ELASTICITY

25. Stresses in a Composite Spherical Gravitating Earth Model

Sisir Chandra Das, Chandernagore.

Stresses have been found for a composite elastic sphere under gravitating forces. Results have been obtained in general terms and in closed forms.

Tangential stresses for a zone up to the depth of 700 km., where the earthquakes rather suddenly terminate, have been calculated in the case of a composite earth model. Comparisons have been made with the homogeneous earth model under same conditions.

26. Love Waves in Hypo-elastic Body of Grade Zero

Gunadhar Paria, Kharagpur.

The propagation of Love waves in the hypoelastic body of grade zero has been considered. It is found that the wave velocity retains the same characteristics as that in the classical linearly elastic body. The difference lies in the fact that one of the normal stresses is not identically zero in the hypoelastic body considered whereas all the normal stresses are zero in the classical elastic body.

27. Stress Distribution within Solids of Revolution

Avtar Singh, Kharagpur.

In this paper the problem of axially symmetric stress distribution within semi-infinite transversely isotropic solids bounded by one or two cones has been considered and a formal solution is obtained with the help of Mellin Transform, under quite general loading conditions. The stresses and the displacements, within such solids, are expressed in term of two stress functions which satisfy two second order partial differential equations.

By various choices of the semivertex angles of the two cones, various types of solids can be obtained. As an example the problem of stress distribution within transversely isotropic semi-infinite solids under a uniform normal loading applied over a circular area is worked out in detail and the results in the special case of isotropy, agree with those previously known.

28. Stresses due to a Centre of Pressure at the Centre on a Circular Disk with an Eccentric Hole

A. M. Sengupta, Ranchi.

In this paper stresses on a circular disk with an unstressed eccentric circular hole have been determined, when the disk is subjected to a centre of pressure radiating uniformly from the centre of the disk.

29. On the Stresses due to an Overlapped Circular Hole on the Neutral Axis of a Deep Beam under Constant Bending Moment

S. B. Dutt, Calcutta.

In the present paper the effect of a small overlapped circular hole on the neutral axis of deep beam under constant bending moment has been discussed. The solution has been obtained by using bipolar coordinates.

30. Stress Distribution around Two Equal Rigid Circular *Inclusions* in an INFINITE Elastic Plate Under Generalised Plane Shear

P. P. Chattarji and S. B. Dutt, Calcutta.

Solutions in bipolar coordinates are obtained for an infinite elastic plate with two equal rigid circular *inclusions* subjected to the action of a uniform shear at infinity.

31. Dislocation of Translation of a Concentric Ellipse

P. N. Shivakumar, Dharwar.

A particular case of stress free boundaries with the strains giving rise to dislocations is considered. The case considered here is the dislocation of translation of a concentric ellipse. The method adopted is using the Conformal Transformation which gives for an ellipse the mapping of a circle.

The complex potentials giving the required dislocation are found in the new transformed co-ordinates and also the necessary complex potentials satisfying the boundary conditions. The complex potentials then got are found to be in the form of an infinite series.

THEORETICAL PHYSICS

32. On Wave Solution of Field Equations in Einstein's Unified Field Theory

N. N. Ghosh, Santiniketan.

A static non-symmetric tensor field $g_{\mu\nu}$ with 4 symmetric components s_{kk}, s_{mm}, s_{nn}, s_{ll} $(k, m, n, l = 1, 2, 3, 4)$ and one anti-symmetric component a_{mn} (the rest being all zeros), involving either the co-ordinate x_k or the co-ordinates x_k, x_m is made non-static by changing x_k into $x_k + \varepsilon x_l$, where ε is a constant. On solving the relevant field equations in the 'strong' form it is found that such a wave solution is generally spurious, being transformable into the corresponding static solution. It is, however, observed that if the field is not spherically symmetric non-trivial solutions in wave form may be constructed.

33. Quantum Mechanics in Curved Space-time

S. P. Misra, Cuttack.

A set of equations for the elementary particles when the space is curved is obtained by substituting the curved space metric for the flat space one in the algebraic relationship that determines the matrices which describe these particles. It is observed that for Dirac or Duffin-Kemmer matrices, the same set of equations are obtained if we assume that the flat space equations are true in the local frame of reference at any point. The above is taken as fundamental postulate. The approximate corrections to the different fields have been obtained. It is also observed that this procedure means a re-definition of the affine relationship. It is throughout assumed that the curvature is introduced in the space-time world due to the presence of matter by the standard relationship of general relativity.

INDIAN MATHEMATICS

34. Indian Influence on Foreign Mathematics—Ancient and Mediaeval —Part I.

U. C. Bardhan, Calcutta.

We want to give a fair idea of what the Indians contributed directly towards the growth and development of the science of mathematics. It is indeed a gift of no mean order in quality as well as in quantity so far as the fundamental ideas and principles are concerned especially in its early stage. We have seen that in some respects they anticipated the works of master minds of later days. Their indirect researches to the science through their immediate followers and disciples was also not of less worth.

Indian mathematics was introduced into Arabia in the second half of the eighth century of the Christian era, chiefly through the attempts of the court of Bagdad. The astronomical and mathematical works of Aryabhatta, Brahmagupta, Lalla and other renowned early Indian mathematicians were translated into Arabic (C. 770) and were highly appreciated.

Another point of importance to be remembered is that the Arabs were familiar with the ancient Indian mathematics before they came to learn Greek mathematics. This has been much attested by Ibn Ezra as has been inferred by Weber, Woepeke and others.

In the 8th and 9th centuries or probably earlier Indian mathematics was introduced to Northern Africa and Spain by the Arab conquerors.

In the East, ancient Indian mathematics entered China together with Buddhism about the beginning of the Christian era. Furthermore, in the 5th and 6th centuries the Chinese culture was greatly predominated by the Hindu culture.

35. S. Ramanujan

U. C. Bardhan, Calcutta.

S. Ramanujan, the greatest mathematician of modern India and one of the greatest mathematicians of the world was born on 22nd December 1887 in a Brahmin family at Erode in the Presidency of Madras. His father was a clerk in a cloth merchant's office.

He had an extraordinary memory and even at a very early age could give the value of π, e, $\sqrt{2}$ etc. to any number of decimal places.

His earliest contribution to the Journal of Indian Mathematical Society was in the form of question in 1911. His first long article was on some properties of Bernoulli's Numbers.

Prof. G. H. Hardy says, "The limitation of his knowledge was as startling as its profoundity. Here was a man who could work out modular equations and theorems of complex multiplication, to orders unheard of, whose mastery of continued fractions was on the formal side of any rate, beyond that of any mathematicians in the world, who had found for himself the fundamental equations of the Zeta-functions and the dominant terms of many of the most famous problems in the analytic theory of numbers. I had to try to teach him and in a measure I succeeded though obviously I learnt from him much more that he learnt from me." At an early age he was elected a fellow of the Royal Society of London. He had then commenced active work, and some of his

most beautiful and important theorems were discovered by this time. He was ill in the spring of 1917.

He was not keeping good health and died on April 26, 1920 at Kumbakonam.

36. Development of Mathematics in Karnataka

K. R. RAJAGOPALAN, Madras.

The paper traces briefly the output of the Kannadigas in the field of Mathematics upto the 18th Century. Raajaaditya, a mathematician who is practically unknown to students of History of Indian Mathematics, is introduced and a brief account of his work is given. Raajaaditya might be the first to write about Mathematics in a local language, viz., Kannada. Other writers who followed in this wake are also mentioned. The paper brings out the need for proper study and critical editing of the several manuscripts scattered throughout the country.

SECTION OF STATISTICS

PRESIDENT : PROF. A. K. BHATTACHARYYA

Abstracts

THEORETICAL STATISTICS

Distribution Theory

1. Distribution of the Canonical Correlations

A. GEORGE, Trivandrum

Hotelling introduced the concept of canonical correlations to study the relation between two sets of random variables $x = (x_1\, x_2\, .\ \ x_q)$ and $y = (y_1\, y_2 \,..\, y_p)$. He constructs two linear functions $u = ay'$ and $v = cx'$ and determines a and c such that the correlation between u and v is a maximum. This correlation is defined as the canonical correlation between the two sets of random variables x and y. It is shown that the population canonical correlation ρ is given by the equation

$$|\rho^2\Sigma_1 - \Sigma_{12}\ \Sigma_2^{-1}\ {}_{12}'| = 0,$$

where Σ_1, Σ_2 and Σ_{12} are the population covariance matrices respectively.

In the case of a sample of size N, the sample canonical correlations are the roots of

$$|r^2S_1 - S_{12}S_2^{-1}S'_{12}| = 0$$

where S_1, S_2 and S_{12} are the matrices formed by the sums of squares and products of the two sets of variables y and x.

Several authors have studied the distribution of the canonical correlations. The present investigation is concerned mainly with the study of the distributions of canonical correlations when one set of variables is held constant in repeated sampling. From this result the distribution for the general case is also derived. The basis for this study is the distribution of rectangular co-ordinates. Matrix methods are used throughout. Though the method is general, explicit expressions are obtained for particular cases only.

2. On the Non-Central F Distribution in Its General Form

M. SANKARAN, Madras

The non-central F distribution in its specialised form is the ratio of the non-central chi square with f_1 d.f. (d.f. = degrees of freedom) to an independent central chi square with f_2 d.f. This is the one usually met with in the literature and has been studied among others by Fisher, Tang, Patnaik and Pearson and Hartley. Martin Weibull seems to be the first to give a wider content to non-central F than is found in the literature. Weibull has defined the non-central F to be the ratio of two independent non-central chi squares weighted with the appropriate degrees of freedom. We shall call this ratio the non-central F in its generalised form and denote it by F'_g. Accordingly F'_s will stand for the non-central F in its specialised form. The present paper deals with some approximations to the non-central F in its general form, i.e. F'_g, with special reference to the evaluation of the percentage points of the F_g' distribution for the probability levels usually chosen in tests of significance.

The first approximation is based on Patnaik's χ^2 approximation to χ'^2. Accordingly $F'_g \sim kF$ where k and the appropriate degrees of freedom for F are directly obtained from Patnaik's results. For the second approximation we write $F'_g = \frac{r_1}{r_2}\frac{f_2}{f_1}\left(\frac{y}{x}\right)^3$ where $y = \left(\frac{\chi_1'^2}{f_1 + \lambda_1}\right)^{\frac{1}{3}}$ with a similar interpretation for x. By Aty's result y and x are approximately normal with means, say, m_y and m_x and variances, say, σ_y^2 and σ_x^2 respectively. If $v = \frac{y}{x}$ then, using Geary's result, $\frac{v m_x - m_y}{\sqrt{v^2 \sigma_x^2 + \sigma_y^2}}$ is approximately $N(0, 1)$. The adequacy of these two approximations is tested with the help of the exact tables of the probability integral prepared by Weibull for selected degrees of freedom and non-centrality parameters. The conclusion reached is that both the approximations are equally satisfactory but the second is preferable to the first in that unlike the first it does not involve extensive interpolation. Also a third approximation based on the Gram-Chalier series expansion to a distribution function is being investigated.

3. Moments of Poisson Distribution

P. N. PHUTANE, Bombay

As all the cumulants of a Poisson's distribution are equal, central moments of Poisson distribution can be obtained from the relations between central moments and cumulants. A recurrence relation in a difference differential equation form between the central moments gives the higher order moments if those of the lower orders are known. An alternative method for deriving the central moments of the Poisson distribution without recurrence relation between the central moments or using any differential equation, is discussed in this paper. Central moments of any order can very easily be derived directly.

In fact, rth central moment is given by, $\mu_r = \sum_{y=0}^{r} B_{ry}\, m^y$

where $B_{ry} = A_{ry} - {}^rC_1 A_{r-1,\, y-1} + {}^rC_2 A_{r-2,\, y-2} \,.\,. + (-1)^y\, {}^rC_y A_{r-y,0}$,

and $A_{st} = \frac{1}{t!}\left[t^s - {}^tC_1 (t-1)^s + {}^tC_2 (t-2)^s - \,.\,. + (-1)^{t-1} t \right]$

$s = 0,1,2, \,.\,. \, r \,;\; t = 0,1,2, \,.\,. \, s.$

The methods for the rapid calculations of A's and B's are also derived. The first twelve central moments of the Poisson distribution are derived.

Theory of Inference

4. On the Relative Efficiencies of BAN Estimates Based on Doubly Truncated and Censored Samples

B. RAJA RAO, Poona

It is shown that the efficiency of BAN (best asymptotically normal) estimates defined by Neyman which involve computation in terms of a doubly truncated or censored probability law is, in general, necessarily less than the efficiency of BAN estimates based on the original (untruncated or uncensored) probability law and further, that the efficiency increases i.e., the loss of information decreases, as $a \leftarrow x_0'$, $x_0'' \rightarrow b$, where x_0' and $x_0''(x_0' < x_0'')$ are the points of truncation, when the underlying probability distributions are continuous, and distributed over the range $a \leqslant x \leqslant b$, where a and b are independent of the parameters to be estimated. This is established for estimates of a single parameter, and, also, for joint estimates of several parameters involved in a probability distribution. In the case of a doubly censored distribution, it is shown that certain amount of information is lost due to not knowing the number of missing observations separately for each "tail". Thus our results indicate that in any case of regular estimation, the use of a truncated or censored probability distribution should always be accompanied by an investigation into the loss of efficiency of estimates used. The corresponding results for a singly truncated or censored sample follow as a special case, by making $a \leftarrow x_0'$ or $x_0'' \rightarrow b$.

5. Multivariate Tests with Power Functions Free from Nuisance Parameters

S. K. CHATTERJEE, Calcutta

If the power function of a test is completely free from nuisance parameters, we can get a more definite idea about the accuracy of the test. Stein (1945) gave a two-sample test of this type, for the general linear hypothesis, based on independent homoscedastic normal observations. In this paper, the problem of developing such a test for the mean vector of a multivariate normal distribution, is considered. The following four cases are discussed :

1) The S.D.'s are known, but the correlation matrix is unknown.

2) The correlation matrix is known, the variables are known to be homoscedastic, but the value of the common S.D. is unknown.

3) The correlation matrix is known, but the S.D.'s (which are not necessarily equal) are unknown.

4) The variance-covariance matrix is totally unknown.

It is shown that in case (1), a single-sample test, with the desired property exists. In case (2), a simple modification of the test for general linear hypothesis, given by Stein, serves the purpose. For the cases (3) and (4) new tests of the desired type are developed only for the bivariate normal distribution and the distributions of the statistics used are also deduced.

6. A Sequential Sampling Plan Based on Attributes for Testing the Mean of a Normal Distribution

AJIT KUMAR BHATTACHARJI, Kharagpur

In the present study, a sequential probability ratio test based on the proportion of items passing and failing to pass through a gauge of given dimension, has been proposed for testing the hypothesis $H_0(\mu = \mu')$ against one-sided alternatives $H(\mu > \mu')$, where μ is the unknown mean of a normal distribution with known variance. A suitable dimension for the gauge to be used has been determined. The relative efficiency of this test procedure compared to the sequential probability ratio test based on the measurement of the variable has been obtained. The feasibility of the use of the test procedure based on gauges in acceptance inspection of lots has been discussed.

7. Sampling Properties of Goodness-of-fit Tests for Autoregressive Schemes

K. C. CHANDA, Bombay

Sampling properties of Quenouille and Bartlett-Diamond tests for autoregressive schemes, as revealed through the first two moments of the test criteria (χ^2's with k d.f. where k is the number of linear compounds on which χ^2's are based) expressed in terms to order k/n, where n is the size of the sample have been investigated. It has been demonstrated that when the sample is not too large, the contributions due to the terms involving k/n are considerably large, a fact which confirms the empirical conclusions of Rao and Som. In view of the apparent loss of validity of tests thus entailed we have suggested a modified test to be used when the sample size is small.

Design & Analysis of Experiments

8. On the Accuracy of Current Approximate Variances of Treatment Differences in Randomised Block Designs with Missing Observations

M. N. DAS and G. A. KULKARNI, New Delhi

Accuracy of the approximate variances of treatment differences in Randomised Block designs as obtained (i) from the effective number of replications (suggested by Yates) and (ii) from the existing number of replications, has been examined by comparing them with the corresponding exact variances. It appears that the variance through Yates' method gives in most of the cases an over-estimate of the true variance, while the other approximate variance is always an under-estimate. The average of these two expressions gives a very close approximation to the exact variance and is an improvement over what was suggested by Taylor.

9. Circular Designs

M. N. DAS, New Delhi

If there be v treatments arranged over a circle in ascending order such that the last and the first treatments become consecutive, then a circular design which is an incomplete block design with v blocks can be obtained by taking all the v sets of k consecutive treatments in a given direction as the block contents. Such designs can be obtained for any value of v. Two-way elimination of heterogeneity is also possible for such designs. As the designs are most effective when $k = 2$, method of analysis has been worked out only for that case. Actually the solution of the normal equations of the design when $k = 2$ can be obtained from :

$$t_i = \sum^{m} s \left(\frac{s}{2m+1} - 1\right) A'_{is}$$

Where $m = \frac{v}{2}$ or $\frac{v-1}{2}$ according as v is even or odd.

and $$A'_{is} = Q^c_{is} + Q^a_{is}$$

where Q^c_{is} and Q^a_{is} are the adjusted totals of the two s-th treatments—one in the clockwise direction and the other anticlockwise—from the i-th treatment. If for certain value of s the two treatment happen to be the same, A'_{is} is the adjusted total of that treatment alone.

10. Latin Square with Orthogonal Partitioning

P. N. BHARGAVA, New Delhi

It appears that orthogonal portions of Latin Squares may have some application for experimentation in various fields. Hence an investigation was made to provide a method of analysis of an orthogonal portion of a Latin Square corresponding to a given orthogonal partitioning of Latin Square. In the present note an attempt has been made to provide a method of analysis of an orthogonal portion of a Latin Square containing (r^2-r) cells corresponding to the orthogonal partitioning into r and (r^2-r) cells. This actually means analysing a Latin Square without the observations in r of the cells such that they are distributed one in each row, column and containing a separate treatment.

APPLIED STATISTICS

Demography

11. An Examination of Mortality Indexes

S. R. ADKE, Poona

The problem of comparing mortality experiences at two different times or places has given rise to a number of index numbers. A change in the total number of deaths may be due to a change either in the rate of mortality or in the number "exposed-to-risk" of death. It is therefore proposed that the ratio of the number of deaths in one situation to that in another situation be expressed as a product of two factors, one measuring the change in rate of mortality and the other that in the "exposed-to-risk". Investigation into the systems of weights employed, leads to the already well known indexes viz. the Standardized Mortality Ratio and the Comparative Mortality Figure.

Some new indexes to measure changes in the exposed-to-risk have been formulated.

Problem of constructing indexes to compare mortality experiences when different rates of mortality exist at the same age has also been solved. An application of the above technique to comparison of sickness experience is pointed out.

12. A Method for Correcting Reported Ages and Marriage Duration Adopted in Village Mukhmelpur

S. N. AGARWALA, Delhi

Ages in India are either under - or over-reported or have digit preferences. These biases are removed by smoothing ages, either by applying a mathematical formula, or by putting single year age data in certain age groups. However, the method which we have adopted is entirely different. At the time of village surveys we collected two direct statements on present age for each ever-married couple, as also some additional information with the help of which three indirect estimates of present age could be constructed. Also, we collected two direct statements on the marriage duration, one each from the husband and the wife, and some additional information which gave us four indirect estimates of the marriage duration. By taking the mode or the mean of the six estimates of the marriage duration we obtained an estimate, which when matched with the actual record of marriage duration kept in the village, showed that in 70 per cent cases the marriage duration was correctly estimated within a margin of two years. Also, when the marriage duration did not exceed ten years, it could always be estimated, by our method, within one year of the "actual". The present age was obtained by adding to the actual or the estimated marriage duration, the reported age at marriage. The present age, thus obtained, had a digit preference of only 12.8 per cent, when calculated by Myers elementary method. This is very creditable by Indian standard.

13. A Study on the Regional Distribution of Population according to Economic Status

ASHUTOSH GHOSH MAJUMDAR, Calcutta

Census of India (1951) provides district-wise population figures according to economic status viz., (1) self-supporting persons (ss); (2) earning dependents (e.d.); (3) non-earning dependents (n.e.d.). In this paper, an attempt has been made to study in detail the regional distribution of population with reference to economic status. The analysis is entirely based on census data. As the census was taken in 1951, the districts referred here are those which existed in 1951. For the present purpose, Manipur, Tripura, A & N Islands, Kutch, Coorg, Ajmer, Bilaspur, Delhi, and Chandannagore have been treated as 'districts'. Jammu and Kashmir and L & M Islands have been excluded from the present study. India has been divided into six population zones (or regions). Distribution of districts according to the percentage of s.s., e.d. and n.e.d. males and females for each of the six population zones have been found out. For each population zone, average percentage of s.s. males per district has been worked out. The difference between the highest and the lowest percentage figures i.e. the range of variation in each population zone has also been calculated. Averages and ranges for five other categories have also been found out.

14. On Estimation of Rates from Large Scale Sample Surveys

K. C. SEAL, New Delhi.

In many large scale sample surveys lasting for a considerable period of time, informations on various types of characteristics are collected by interviewing different sets of households at different periods of the survey and by employing a suitable reference period which may be quite long in some cases. Sometimes due to inadequate sample size taken in any round of the survey, data are also pooled for several consecutive rounds to arrive at a reasonably good estimate of a certain characteristic. Any characteristics of the population, such as the per capita income or expenditure, the estimated birth or death rate or the rate of natural increase or of migration etc. depend not only on the total number of births, deaths, income, etc. occurring during the period of the survey but also depend on a valid estimate of the average size of the population surveyed during the entire period for whom the desired characteristics are to be studied. This paper indicates how to derive the average size of population during the entire period of survey to which the total frequency of the desired characteristics occurring during the entire period may be related. The most representative point of time at which the estimated rate is likely to be applicable is also discussed.

Economic Statistics and Quality Control

15. A Statistical Analysis of the Cost of Cultivation and Yield of Cotton in Coimbatore District

C. S. Raman, Madras.

A pilot-survey was conducted recently, selecting fifty villages in Coimbatore District by the technique of simple random sampling, to study the marketing structure of cotton which happens to be the most important commercial crop in the district. The report on the survey appears in a different paper. In this paper an attempt is made to analyse the cost structure so as to bring out its relationship with the yield of cotton, and certain measures to step up the total output of cotton in the district have been suggested.

16. Control Limits for Mean of Gamma Type Population

S. B. Chaudhuri, Calcutta

For small sample size, as is generally the case, in industrial problems, the calculation of control limits on 3σ rules on the basis of normal distribution is erroneous. In case, the distribution of the sample statistic is known, probabilistic limits are definitely better than 3σ limits which are often used as a method of action.

In this paper upper and lower 5% control limits have been calculated for the mean of Gamma Type population for various values of p, the parameter in the population distribution and of n, the sample size.

Psychometry

17. Reliability Coefficient as a Measure of Adequacy in Behaviour Model

P. K. Bose, Calcutta

By macro-analysis of test scores we get a typical behaviour model for a particular test j in the form

$$Z_j = \sum_{r=1}^{m} a_{jr}F_r + b_j S_j + C_j T_j.$$

The reliability coefficient may be obtained from such a model as

$$r_{jj}^{(1)} = \sum_{r=1}^{m} a_{jr}^2 + b_j^2.$$

By micro-analysis of item scores for the same test we can get another value of the reliability coefficient as $r_{jj}^{(2)}$,

$r_{jj}^{(1)}$ and $r_{jj}^{(2)}$ can be used for testing the adequacy of the behaviour model.

18. Equivalence Curve Method of Equating Scores in Two Forms of a Test given to Two Different Groups.

B. Das Gupta, Calcutta

The problem of equating scores in two forms of a test X & Y given to two different groups was tackled by several authors. The method in all the cases is to apply a third test Z to both the groups and to estimate the means and standard deviations of tests X & Y for the combined group. This estimation is based on a number of assumptions about the score distribution of X & Y and the regressions of X on Z and of Y on Z, which may not be satisfied in actual cases. In this paper an alternative method is suggested adapting the equivalence curve method of scaling as proposed by Bose and Chaudhury (1955) with necessary modifications.

Miscellaneous

19. Madras State Elections (1957)—An Analysis

K. R. RAJAGOPALAN, Madras

The paper presents the results of the last General Elections in the Madras State – both for the Assembly and for the Parliament. The number of seats contested, won and lost, votes secured etc., are all analysed. The number of votes secured by a candidate is considered in the form of *three* averages—the general average, the "success average' and the 'failure average'. Based on these, the organizational strength of the party or the individual strengths of its members is indicated. Analysis is also presented on the percentage of 'outright' wins and wins by 'split of votes' for the various parties. Other aspects such as --Single and Double-member Constituencies, Women Candidates, Losing Deposits etc., are also brought out.

20. Seasonal Variations in the Mortalities of the Insect *Culex Fatigans* Weid Exposed to DDT

N. K. CHAKRAVARTI, Kanpur

Variations in the mortality of the insect *Culex Fatigans* Weid when exposed to DDT have been studied by Ranganathan and Koshi with the help of data collected every fortnight in the Defence Research Laboratory (Stores), Kanpur beginning September, 1949. The statistical analysis of the data is presented in the present paper. It appears from the analysis that over and above the significant influence of humidity and the influence, though not significant, of temperature on mortalities, there is a marked seasonal pattern exhibited by the mortalities.

21. Variations in the Distribution of Susceptibilities of a Population

N. K. CHAKRAVARTI, Kanpur.

It is well known that the distribution of susceptibilities of a population of insects and animals to a drug or poison changes from day to day even in the same laboratory. However, no attempt appears to have been made so far to obtain an explanation of the nature of those variations. The author has, in another paper, shown that these variations appear to be seasonal, even after corrections for changes in temperature and humidity; and that the *LD*-50 and the slope of the dose-response relationship increase or decrease together. A theory is enunciated in the present paper that there is a maximal dose at which every individual of a population succumbs. An analysis of the data presented in the author's other paper shows this theory to be plausible.

SECTION OF PHYSICS

PRESIDENT : PROF. A. K. DUTTA, D.Sc., F.N.I.

Abstracts

THEORETICAL

1. Resistance of a Circular Cylinder due to a Pair of Vortices Moving Symmetrically

KUMARI DURGA ROY, Calcutta

In actual problem when a cylinder is introduced in a uniform stream the vortices are generated symmetrically and finally they move down satisfying the phenomena of Karman-vortex street.

In this problem a circular cylinder of radius c is introduced with its centre at origin in a uniform stream $\vec{U}$ along X axis and is attended by a pair of vortices

$$-K \text{ and } -K \text{ at } Z_0 \text{ and } Z_0.$$

Here the resistance experienced by the cylinder is calculated when the pair of vortices move symmetrically.

2. On the Question of Introducing Sphericity Considerations to the Problems of Radiative Transfer in Stellar Atmospheres.

K. K. SEN, Chandernagore

The problem of applying the correction for the spherically symmetrical nature of the stellar atmosphere over the plane parallel one in the case of radiative transfer is discussed in the paper.

3. Asymptotic value of Optical thickness of a Spherically Symmetric Stellar Atmosphere in the non-conservative case in the Second Approximation

K. K. SEN, Chandernagore

The asymptotic value of optical thickness of a spherically symmetric stellar atmosphere has been calculated in the second approximation for non-conservative isotropic scattering. The method of solution of integro-differential equation of transfer due to Chandrasekhar, in which the integrals have been replaced by the corresponding Gaussian sums, has been used. The second approximation values of the optical thickness are found to modify the values of optical thickness obtained previously by the author in the first approximation.

4. Charge Exchange Cross Sections of Argon Ions in Hydrogen Molecule

S. B. Karmohapatro, Calcutta

Charge Exchange cross sections of low energy argon ions in hydrogen are calculated by the semi-quantum mechanical impact parameter method, improved with a better approximation of the wave functions. Cross section curves for the reactions in the different states are compared with the experimental curve so that the part of each of the different reactions in the experiment may, approximately, be evaluated.

5. On the Analytic Relationships between Potential Energy and Internuclear Distance of Diatomic Molecules

B. B. Laud, Poona

The relative advantages and disadvantages of several functions relating the potential energy and the distance between two bonded atoms has been discussed. The function

$$V = De\,[\,1 - exp\,\{-n\,(\Delta R)^2/2R\}\,]$$

recently derived by Lippincott from a simple quantum mechanical model through the use of perturbed delta functions has been examined in detail. Dissociation energies and anharmonicity constants have been calculated using the above function as well as Morse function. Though no agreement is obtained in either case with the experimental values, it is found that the differences between the experimental and calculated values are considerably narrowed down in the case of Lippincott's relation. This and other considerations show that it is a better approximation to the true potential energy curve.

D_0 values calculated using the empirical relation for the parameter n suggested by Lippincott, however, gives results which are widely in error, indicating that the relation is quite inadequate and hence cannot be used in predicting or correlating bond properties of molecules. It is suggested that n be defined in terms of electronegativities.

6. Bound States in Quantum Electrodynamics

T. C. Roy, Jadavpur

Exact equations of bound states are obtained and a method is proposed for solving such equations which differ from the usual Tamm-Dancoff method. Here the Coulomb field is first separated and forms the glue field for binding, whereas the transverse electromagnetic field is used as a perturbation for corrections like Lamb effect. The method seems to have an advantage that it can treat problems including both free and bound states. As an example is considered the case of Bhabha-type scattering in which the final state is a positronium and a light quantum.

7. Solution of the Dirac Equation for Electromagnetic Potentials

N. C. Rastogi and Vachaspati, Lucknow

Following a work of Eliezer (1958), the Dirac equation for an electron interacting with an electromagnetic field has been solved for electromagnetic potentials. Only three of the four equations are independent. Explicit expressions for the potentials are obtained in terms of the electron wave function, its derivatives and a linear combination of the potentials.

8. Non-linear Quantum Mechanics and Riemannian Geometry in Complex Spaces

VACHASPATI, Lucknow

The author has previously attempted a generalization of the Hilbert space of quantum mechanics in analogy with the development of the general relativity theory from the theory of special relativity. The space considered there was of finite dimensions. A generalization is now made to infinite dimensional space in which the elements are labelled by a continuous parameter. It is shown that the use of integrals in the transformation theory has to be given up. In its place we have to use functionals which refer not to a single point at a time, but to all the points of space at once. These functionals are known when we know all the possible derivatives of the function involved at a given point. A tensor calculus can be developed regarding those derivatives as independent variables. Apart from the possible application of this formalism to the construction of alternative forms of quantum mechanics, it is hoped that this work will provide at least a first step towards the construction of Riemannian geometry in functional space.

9. Solution of Cauchy's Problem for the Wave Equation

$$\left[\left(\frac{\partial^2}{\partial t^2} - \nabla^2 + k^2\right)\psi = 0\right]$$

S. C. MALVIYA, Lucknow

A method given by Copson (1956) has been generalized to obtain a solution of Cauchy's problem for the meson type wave equations in any odd number of spatial dimensions. The method does not involve the use of any device for evaluating the divergent integrals.

10. 'The Theory of Pressure Ionisation and its Application to the Planetary Interiors'

V. S. MATHUR and D. S. KOTHARI, Delhi

The original 'Pressure Ionisation' formula has been modified by taking account of 'exchange interactions' in the electrons, and the effect of this modification on the mass-radius relationship of 'cold' configurations is investigated. The results of calculation, on alternative assumptions regarding the planetary compositon, support Ramsey's viewpoint that the 'cores' of Earth and Venus are composed, not of Iron, but of ionised (degenerate) matter—the mean atomic weight of elements constituting the whole planet being about 20. The pressure 1.4×10^{12} dynes/cm^2 at the boundary of the Earth's core is, according to Ramsey, interpreted to be the pressure at which 'Olivine' (the material supposed to constitute the Earth and other 'terrestrical' planets) undergoes a transition from 'molecular' to 'metallic' phase; in other words it has been assumed that beyond this pressure matter begins to be ionised on account of high pressures. A calculation of the masses and radii of the cores of Earth and Venus has been made on this hypothesis and the calculated values are found to be in satisfactory agreement with those computed by Bullen.

Nuclear Theory & Experiment

11. Polarisation due to Anomalous Magnetic Moment of Nucleons

D. Basu and S. Sarkar, Calcutta

Introducing an invariant interaction of the form $F_{\mu\nu}\gamma_\mu\gamma_\nu$ in the Dirac equation we have calculated the expression for the polarisation of the scattered particles in relativistic Born approximation. The result agrees with Wolfestein's expression if we put the energy $E = m$ (mass).

12. Proton-Nucleus Scattering at 96 Mev.

D. Basu and A. Ghosh, Calcutta.

For the study of proton-nucleus scattering at 96 Mev, we choose a potential, the nuclear part of which has the form $(V + iW)/[1+e^{(r-R)/a}]$, R and a are known as the halfway radius and the diffuseness parameter respectively. R is expressed as $R = r_0 A^{1/3} \times 10^{-13}$ cm, V and W are the parameters that determine the strength of the nuclear potential. In addition to the nuclear potential, we have the Coulomb potential similar to that of uniformly charged sphere. In this we have calculated the cross section for the proton-nucleus scattering at 96 Mev. in the Born approximation with the above potential and compared the same with experimental results. The idea is to see how well such a velocity independent and central potential can explain the angular variation of the scattering cross section at high energies. To obtain the best fit with observational results, we have varied the parameters. It is found that because of the imposition of a nuclear boundary at R, fluctuating terms of the form $\cos KR$ and $\sin KR$ occur in the scattering amplitudes. The positions of the maxima and minima are determined by r_0, the influence of other parameters is very little. For the case of silver, the following parameters give the nearest approach to the experimental curve. $V = -1.9$ Mev, $W = -28.5$ Mev, $a = 0.6 \times 10^{-13}$ cm, $r_0 = 1.33 \times 10^{-13}$ cm. It must be borne in mind that the validity of Born approximation is not very good.

13. Electron Capture by Protons passing through Hydrogen

N. C. Sil, Calcutta

A variational method valid for both low and high incident proton enegies is applied to the problem of electron capture by protons from the ground state of hydrogen atoms. Because of the heavy mass of a proton compared with that of an electron the collision process is treated as a simplified one body problem, viz., that of an electron in the Coulomb fields of two protons. The calculation is made in the coordinate system in which the centre of mass of the two protons is at rest while the protons move with uniform velocities—equal in magnitude but opposite in direction—in straight lines; the effect of the proton-proton interaction is completely neglected. Initially the electron is attached to one of the protons in its ground state. Due to the perturbation of the second proton the original state of the electron undergoes modification; the time rate of change of the wave function representing the state of the electron is given by the time dependent Schrödinger equation with a Hamiltonian appropriate to the situation. In the variation integral, the stationary value of which yeilds the time dependent Schrödinger equation we substitute for the actual electron wave function, a trial wave function which is a linear combination of the two ground state wave functions around the two protons, the coefficients being free as functions of time. We perform the space integration in the variation integral, and then, making stationary the resulting time integral, we obtain the differential equations to determine the capture probability. The capture cross section is next calculated in the usual way.

The numerical results of our calculations for the capture cross sections at low incident proton energies agree closely with those of Dalgarno and Yadav (1953). With suitable assumptions our approximation may be easily reduced to the approximation of Brinkman and Kramers (1930) or to the approximation of Jackson and Schiff (1953). The lack of orthogonality of the initial and final state wave functions in capture problems raises serious doubt as to the validity of the ordinary perturbation calculations for these cases ; our treatment is free from this objection.

14. Renormalization for N-$\bar{N}$ Interaction

A. N. Mitra and R. P. Saxena, Aligarh

The nucleon-antinucleon interaction which differs from the corresponding $N-N'$ interaction in respect of the annihilation term has been studied in the framework of the new Tamm-Dancoff formalism. The annihilation term, even in the lowest order, gives rise to renormalization effects similar to those encountered in π-p scattering in the S- and p- states of $T = \frac{1}{2}$. This has been carried out completely for the $N-\bar{N}$ interaction. It has been found that unlike the case of π-p scattering where two different renormalized coupling constants appear, the present problem leads to a unique value for this parameter. This feature of $N-\bar{N}$ interaction makes the renormalization programme more consistent than is the case with π-p scattering.

15. Non-local Reaction Matrix in the Shell Model

Manoj Kanti Banerjee, Calcutta

An explicit form for the non-local reaction matrix has been obtained under several simplifying assumptions. This has been parametrised by a quantity called the correlation length. The reaction matrix has been used to obtain the separation of the center of mass of the excited levels of Ca^{42} with respect to the ground state. An agreement with the experimental value is obtained for a correlation length of 10^{-14} cm. The hard core contributes about 35% and the non-local part about 20% of that due to the smooth attractive potential to the total excitation.

16. On the Formation of Gaps in Nuclear Emulsion Tracks

Yog Prakash and A. P. Sharma, Aligarh

Total gap length or mean gap length has been used recently as one of the parameters for the identification of particles leaving their tracks in an emulsion plate. Formulation of any relation concerning the gap involves the assumption of a probability (P) that any grain will be sufficiently affected by the passage of an ionizing particle to initiate the development. The authors have calculated the value of this probability by considering the variation in sensitivity, size, etc. The calculated form of probability has been compared with the forms assumed by other authors. This form of the probability has been taken as a basis for finding a relation connecting the gap length with the number of gaps.

17. On the Exact Solution of Transport Equation for Neutron Diffusion : δ-Function Plane Source

SANTI RANJAN DAS GUPTA, Calcutta

We are applying Wiener-Hopf technique to obtain an exact, explicit solution of the transport equation governing the passage of mono-energetic neutrons diffusing isotropically through a plane-parallel slab of non-capturing medium containing a unit delta function plane source of neutrons at the middle of the slab. With the help of the alternative form of $H(z)$ (which gives the law of limb-darkening in the case of isotropic grey scattering of radiation in the outer layers of a star) as deduced by the author, it has been possible to obtain the emergent neutron distribution $I\ (0,\mu)$ in a simple form as given by (μ is the cosine of the angle of emergence)

$$I\ (0,\mu) = (\sqrt{3}/2)\ H\ (\mu) + \tfrac{1}{2}H\ (\mu)\ r\ (\mu) - \sqrt{3}\ C\ (b)\ H\ (\mu) - \tfrac{1}{2}H^2\ (\mu)\ exp\ (-b/\mu)/\mu$$

where $C(b)$ is a function of the half depth b of the slab and is easily determined by the standard method of numerical integration.

$$r\ (\mu) = \int_0^\infty \frac{H(iy) + H(-iy)}{\pi} \left\{\cos b/y + (\mu/y) \sin b/y\right\} dy/(y^2 + \mu^2)$$

$[\ H\ (iy) + H\ (-iy)\ ]$ is a smooth curve having the value 2 at the origin and rising uniformly to the fixed value 2 (1.07894) at infinity. Since b is sufficiently large the error in replacing $[\ H\ (iy) + H\ (-iy)\ ]$ by the constant value 2 (1.07894) for the evaluation of the last integral will be quite small and in that case

$$r\ (\mu) = 2\ (1.07894)\ .\ exp\ (-b/\mu)/\mu$$

When b tends to infinity

$$I\ (0,\mu) \rightarrow (\sqrt{3}/2)\ H\ (\mu).$$

18. Exchange Effects in Stripping Reactions

M. A. NAGARAJAN, Calcutta.

The effect of the antisymmetrization of the projectile with respect to the A particles of the target has been considered in some detail in a stripping (or pick-up) reaction. The stripping amplitude is shown to consist of two contributions, namely, the direct (or Butler) stripping amplitude and the exchange (or the heavy particle) stripping term. The expression for the cross section will contain, in addition to these two terms, the interference term between these two amplitudes. Calculations of the angular distributions for the reactions $Be^9\ (d, p)\ Be^{10}$, $Be^9\ (\alpha, n)\ C^{12}$, $O^{16}\ (d, p)\ O^{17}$ and $F^{19}\ (d, p)$

F^{20} were made and these were seen to agree very well with the experimental angular distribution curves in these reactions. The calculations also seem to establish that in reactions where the direct and exchange amplitudes are comparable in a range of scattering angles, the interference term plays a decisive part in determining the nature of angular distribution.

19. Stability of Nuclear Octupole Deformation

PARESH MUKHERJEE and ILA DUTT, Calcutta

The Hamiltonian of a single particle moving in a pear shaped potential as proposed by Lee and Inglis, has been discussed. In order to investigate the effect of spin-orbit coupling in a field of octupole deformation, a simpler radial form has been suggested. A Nilsson representation is chosen and the eigenvalues are calculated by exact diagonalisation.

20. Nuclear Deformations in the Excited States

ILA DUTT and PARESH MUKHERJEE, Calcutta

The moment of inertia of the rotational bands in the upper vibrational states of some heavily deformed nuclei are found to differ markedly from that of the ground state band. This may be due to a difference in the configuration of nucleons or to a change in the deformation of the nucleus. In order to investigate the cause of this deviation the equilibrium deformation of some nuclei in the ground states as well as in the excited states have been calculated in the individual particle model of Nilsson. It is found that the deformation remains practically unaltered. Using Nilsson's eigenfunctions the electric dipole transition probabilities have also been calculated and it has been found that in most of the cases the retardation is maximum when the deformation of the excited state coincides with that of the ground state.

21. The Pure $f_{7/2}^2$ Configuration and the Energy-levels of Ca_{42}

B. DUTTA-ROY, Calcutta.

The spin assignments of the energy-levels in Ca^{42}, belonging to the $f_{7/2}^2$ configuration, are discussed. Without admitting configuration mixing, it is investigated, how far the level separations of Ca^{42} can be reproduced by employing (a) Serber-exchange central, (b) Serber-central with odd-state central force as well, (c) Serber-central with odd-state tensor force, (d) Serber-central with odd-state central and tensor forces. Gaussian radial dependence of the potential has been used though some calculations have also been made with the Yukawa potential. It is concluded that an agreement with the observed level scheme for Ca^{42} (as adopted by us), is not possible within the pure $f_{7/2}^2$ configuration and the potentials mentioned above (with reasonable range and odd-state force mixture). Moreover, it is argued, that even if one can find a potential, that reproduces the levels of Ca^{42} with a pure $f_{7/2}^2$ configuration, it will not be possible to obtain the leavels of Ca^{43}, envisaged as being due to a pure $f_{7/2}^3$ configuration.

22. On the Angular Co-relation of the two Gamma Cascades in Rh^{103}

BRAT PAL SINGH, Aligarh

Gamma-gamma angular correlation of two cascades of 555Kev.-55Kev. and 440 Kev.-55Kev. has been studied in Rh^{103} using two scintillation spectrometers in coincidence. The resolution of coincidence circuit is 2×10^{-7} Sec. The co-relation functions thus obtained are as follows :

For 555 & 55 Kev. cascades :

$$W(\Theta) = 1 - 0.152 \pm 0.011 \ P_2 \ (\text{Cos} \ \Theta) - 0.042 \pm 0.017 \ \ P_4(\text{Cos} \ \Theta)$$

For 440 & 55 Kev. cascade

$$W(\Theta) = 1 + 0.049 \pm 0.013 \ P_2 \ (\text{Cos} \ \Theta) - 0.016 \pm 0.017 \ \ P_4(\text{Cos} \ \Theta)$$

The spins of the levels 650 Kev., 538 Kev., 95 Kev. has been discussed in the light of these directional co-relation results.

23. Fermi gas model and rotational States

K. KUMAR, Bombay

If a constraint of net angular momentum is applied to a Fermi gas certain terms appear in the corresponding energy expression which depend on this total angular momentum. The most important of these can be interpreted as rotational energies. Applications to the case of nuclei, in particular' to the explanation of the moment of inertia anomaly, will be discussed.

24. A Note on W. K. B. Approximation in the Theory of Alpha Disintegration

MANUJENDRA LAL CHAUDHURY, Dhanbad.

The total wave function for α-particle needs inclusion of the term $e^{-\lambda t/2}$ to account for the exhaustion of the source. Hitherto the consequence of this on the wave-equations for special function has not been considered which is not justified.

In the following we shall take into account the change in wave equations from above considerations and find superior forms of solutions from W.K.B. approximation. With these solutions and following a more or less usual procedure, a formula for disintegration constant λ has been obtained which is different from the conventional one in the coefficient and is in somewhat better agreement with experiment.

25. On the Isotropic Hyperfine Interaction in Paramagnetic Resonance Spectrum

A. MUKHERJI and **T. P. DAS**, Calcutta.

Attempts have been made in explaining the isotropic part of the hyperfine structure observed in paramagnetic resonance spectrum. In a paramagnetic ion, the exchange interactions of the unpaired electrons exist only with the electrons with their spins parallel to the total spin angular momentum $\vec{S}$ of the ion. This produces slightly different spatial dependence of the wave function for a particular orbital state as the spin is parallel or antiparallel to $\vec{S}$. So each pair of s-electrons in the ion have finite spin density at the nucleus, which produces the isotropic h.f. splitting through the Fermi-type interaction. In this article the problem has been treated by the variation method taking detrminantal wave function for the ion Mn^{++}.

26. Approximations in Brueckner Theory

Suprokash Mukherjee, Calcutta

In this paper the possibility of approximating the G-matrix of Brueckner is discussed and a particular approximation is tested by calculating the volume energy of a large system.

27. The Use of 6810 (R.C.A.) in γ-ray Spectroscopy

A. P. Patro, Calcutta

The use of 6810 has been demostrated for γ-ray spectroscopy work without the use of linear amplifiers. The linearity has been tested and the maximum output voltage was found to be $\approx$ 80 volts.

28. Use of LiI(Eu) as a Scintallation Detector for Intermediate Energy Neutrons

G. K. Mehta and B. Basu, Calcutta

The scintillation response of LiI crystals to neutrons is studied. The best energy resolution with enriched phosphor for products of $Li^6(n, \alpha)H^3$ reaction, obtained is 10%. The value of (neutrons pulse height/gamma ray pulse height) ratio is found to be 0.67. For comparisons measurements are also taken with LiI (Eu) unenriched phosphor and LiI(Tl) phosphor. The energy resolutions obtained with these are 15% and 18% respectively and n/β ratios are 0.87 and 0.82 respectively. The decay time of LiI(Eu) phosphor is found to be 2μ sec.

29. Level Scheme of P_r^{144}

A. K. Sengupta, J. Lahiri, P. N. Mukherjee and
R. Bhattacharyya, Calcutta

Level scheme of P_r^{144} (from the decay of C_e^{144}) has been studied. The γ-spectrum, β-spectrum have been studied and angular correlation measurement is proceeding. Relative branching of the β's has also been established.

30. Measurement of Photoelectric Cross Section of Lead for Cobalt-60 Photons

A. M. Ghosh, Calcutta

Although photoelectric cross-section of elements have been investigated by several workers, as yet there is no generally applicable method which yields its value with reasonable accuracy. The spherical symmetry method has been applied to investigate the possibility of developing a new method for this purpose. In this method the effect of scattering has been eliminated by making the experimental arrangement spherically symmetrical. A cobalt-60 source is placed at the centre of lead spheres of variable thickness and the intensity of the transmitted gamma rays is measured by a G.M. counter. Contribution of pair production to the total absorption cross-section is subtracted out by using the experimentally established semi-empirical formula for the former cross section. Effect of multiple scattering has been taken into consideration by using a correction formula, which has been developed for this type of experiments. Effect of compton degeneracy on the detector efficiency has been taken into account by using water scatterer, the photoelectric cross-section for which is negligible. The experimental value shows reasonable agreement with the theoretical values. Arrangements for improving the accuracy of the method is discussed.

31. Decay of Ruthenium—105

HARIHAR and BABULAL SARAF, Bombay

The 4.5 hour activity of Ruthenium associated with the isotope Ru^{105} and produced by slow neutron irradiation of Ruthenium, has been studied by a Scintillation Spectrometer. It has been found to emit gamma rays of energies ~70, 130, ~170, 260, 310, 380, 460, 650, 725, 860 and 950 kev. Beta-gamma and gamma-gamma coincidences have been studied to establish the level scheme of Rh^{105} nucleus.

32. Measurement of Thermal Neutron Cross-section for the Production of Isomers

M. L. SEHGAL and H. S. HANS, Aligarh

Thermal neutron activation cross-sections for the production of isomers have been measured for a number of cases by making irradiation near the core of the swimming pool reactor at Trombay. Au^{197} was taken as a standard substance with $\sigma th = 98$ barns. In each case the percentage of resonance neutrons has been taken into account by measuring the cadmium ratio. Scintillation technique has been employed for the measurements of the cross-sections. A well type of NaI(Tl) crystal mounted on a 6292 Du-mount photo-multiplier tube was used as a detector. In every case, the half-life curve was drawn to make sure that the isomer under consideration has been produced.

The cross-sections measured are (1) Ba^{136} (n, γ) Ba^{137m}, $\sigma = 9.9 \pm 2.0$ millibarns. (2) Dy^{164} (n, γ) Dy^{165m} ($T_{\frac{1}{2}} = 1.28$ minutes), $\sigma = 2019 \pm 269$ barns. (3) Ge^{74} (n, γ) Ge^{75m} ($T_{\frac{1}{2}} = 49.8$ secs), $\sigma = 13.3 \pm 2.5$ millibarns. (4) Ge^{76} (n, γ) Ge^{77m} ($T_{\frac{1}{2}} = 1.06$ Minutes), $\sigma = 257 \pm 40$ millibarns. (5) Rb^{85} (n, γ) Rb^{86m} ($T_{\frac{1}{2}} = 1.7$ minutes), $\sigma = 11.3 \pm 2.5$ millibarns. (6) Sb^{121} (n, γ) Sb^{122m} ($T_{\frac{1}{2}} = 4.3$ minutes). $\sigma = 1.6 \pm 0.5$ barns. (7) Se^{78} (n, γ) Se^{79m} ($T_{\frac{1}{2}} = 3.5$ minutes), $\sigma = 70 \pm 12$ millibarns. (8) Se^{76} (n, γ) Se^{77m} $\sigma = 11.8 \pm 3$ barns.

33. On the Study of Au^{195} with Scintillation Spectrometers

R. K. GUPTA, S. JHA and M. NARAYAN RAO, Bombay

The electron capture decay energy of Au^{195} has been determined from the ratio of the probabilities of the *L* electron capture and the *K* electron capture, measured in a coincidence scintillation spectrometer. The value of P_L/P_K has been found to be $5.9 \, {}^{+0.9}_{-0.9}$, from which the total decay energy comes out to be 223 $^{+1}_{-1}$ Kev. By studying the spectrum with Au^{195} source placed between two bare NaI crystals, it has been shown that there is a considerable transition to the ground state of Pt^{195}.

34. On the Decay of Promethium^{149} and Promethium^{151}

S. JHA and R. M. SINGRU, Bombay

Beta ray spectrometer and scintillation spectrometer studies of Pm^{149} and Pm^{151} milked in an ion exchange column from pile-irradiated neodymium are described. A gamma ray of 1500 Kev. energy attributed to Pm^{151} has been shown to be non-existent. The end point of the beta spectrum from Pm^{149} has been found to be 1025 Kev. A gamma ray of 300 Kev. has been found to follow the beta decay.

35. On the Detection of the Circular Polarization of Gamma Rays

S. JHA, G. B. YODH and P. AMMIRAJU, Bombay

Methods of detecting the circular polarization of gamma rays by Compton scattering from oriented electrons are described. The results of the the studies of the circular polarization of the external bremsstrahlung of the beta rays from Tm^{170} and P^{32} are given. The special technique employed and the results obtained for the study of the circular polarization of the inner bremsstrahlung associated with the electron capture decays are described.

36. On the Gamma Rays from Xenon^{133}

H. G. DEVARE, S. JHA and B. K. MADAN, Bombay

The gamma spectrum of $Xenon^{133}$ has been studied in a scintillation spectrometer. Gamma rays of energy 80 Kev, 160 Kev. 300 Kev. and 380 Kev. have been observed, the relative intensities being 100 : 1 : 0.02 : 0.01. The log ft values of the three beta branches are estimated. A decay scheme is given. The results agree with the previous study of the decay of Ba^{133}.

37. Nuclear Lifetime Measurements in Millimicrosecond Range

S. K. BHATTACHERJEE and BALDEV SAHAI, Bombay

Knowledge of lifetimes of excited nuclear states being intimately connected with spin change is very important for assignment of multipole orders to the radiation emitted in nuclear transitions. A coincidence scintillation spectrometer of the fast-slow type with a resolving time ~ 2,3 millimicrosecond has been employed for the measurement of lifetimes of some nuclear excited states. Lifetime of the first excited state of Cs^{133} as reached by electron capture decay of Ba^{133} has been measured by taking delayed coincidence curves. Some other measurements, for example, those of the first excited states of Sm^{152}, and Gd^{154} will also be reported.

38. A Comparative Study on Low Level and Conventional Counting Techniques in a Tracer Investigation

FAZLE HOSAIN and B. D. NAG, Calcutta

A comparative study of different types of radiation counting arrangements, viz., a low level technique ; and conventional counting techniques like gas flow counter, thinwalled end-window β-counter, liquid GM counter, end-window type gamma counter and scintillation counters has been made for I^{131}. A tracer experiment, using low and conventional doses of radioiodine in human subjects, has been carried out with reference to 24th hr. plasma iodide and plasma protein-bound iodine fractions as index for thyroid function and iodine metabolism and the results obtained with different counting techniques have been tabulated and discussed.

39. On the Study of the Chemistry of Scandium on a Tracer Scale with Sc^{46}, Part II.

B. C. PURKAYASTHA and V. R. PAI VERNEKER, Calcutta

This investigation deals with our further study on the existence of scandium alum using chrome alum and ferric alum as host constituents. It has been found that scandium is carried through mixed crystal formation when chrome alum is precipitated by alcohol. Chrome alum when precipitated by glacial acetic acid in pressence of scandium tracer does not carry any scandium. The behaviour of freshly precipitated chrome alum by alcohol leads us to conclude that scandium also forms a double sulphate $KSc(SO_4)_2\ 6H_2O$ like the chrome alum $KCr(SO_4)_2.\ 6H_2O$ studied by Venable and Miller. The complete elution of trace amount of scandium leads us to conclude that scandium alum $(24H_2O)$does not exist. Europium also is carried by chrome alum when precipitated by alcohol.

We found that when ferric alum is precipitated by ethyl alcohol scandium is carried through mixed crystal formation. An analysis of the freshly precipitated solid phase leads us to a composition like $4(NH_4)_2O.\ 3Fe_2O_3.\ 12SO_3.\times H_2O$, which was observed by earlier workers. The constancy of the distribution factor leads us therefore to conclude that a compound of scandium of analogous composition does also exist.

Subsidiary to this work it has been found that neither chromium sulphate (violet) nor aluminium sulphate $(16H_2O)$ does carry any scandium activity but potassium sulphate has been found to carry scandium to a considerable extent. The uptake in this case is in close agreement with Freundlich's Adsorption Isotherm.

40. Estimation of Dry Mass Thickness of Biological Samples by Electron Microscopic Method

P. SADHUKHAN, Calcutta

The mass thickness of the cell membranes of a number of biological samples were determined from the quantitative measurements of the contrasts presented by their electron micrographs. The biological samples *Escherichia coli*, Red blood corpuscle and *Leishmania donovani* in suspended medium were first disrupted with distilled water to get their inside materials removed from the cells. The dry cell membranes supported on the collodion film were then micrographed with the help of Siemens' Elmiskop I at an accelerating beam potential of 60 K.V. and with an objective aperture diameter of 50 μ corresponding to the aperture angle of 9.124×10^{-3} radian. The micrographs were taken with exposure times adjusted from a knowledge of the determination of the exposure-density curve of the photographic plate so that the image density should fall in the linear region of the curve. The photographic densities corresponding to the cell membrane and the collodion film were measured by a densitometer. Leisegang's recent theory of scattering cross-section was employed to estimate the image contrast due to the scattering of the beam electrons by the specimen atoms. With the help of these data the mass-thicknesses of the dried specimen were estimated. Finally a nomogram was drawn for quick determination of thickness of biological samples corresponing to any photographic density, accelerating beam potential, slope of the photographic plate and density of the particular sample.

Spectroscopy

41. Dispersion of Microwaves in Compressed Oxygen

PREM SWARUP, Allahabad

The dispersion of microwaves has been theoretically calculated in the case of gaseous oxygen on the basis of the VanVleck-Weisskopf expressions for the collision broadened microwave spectral lines. Oxygen is electrically nonpolar but magnetically polar with moment of 2 Bohr magnetons. The molecule shows resonance absorption at 60 KMc/sec where a number of lines are clustered, which merge due to the collision broadening to give a single broad line with centroid frequency of 2 cm^{-1} and the nonresonant or Debye type of absorption. Dispersion curves are plotted at pressures of 1, 2, 10, 25 and 50 atmospheres in a wide frequency band both for resonant and nonresonant cases. The known static value of the magnetic susceptibility compares very well with the calculated value.

42. Intensity Studies of Overtones in Raman Effect

G. THYAGARAJAN, Annamalainagar

The integrated intensities of the overtones at 1550 cm^{-1} and 1520 cm^{-1} in the case of the liquids CCl_4 and $CHCl_3$ respectively have been obtained relative to the intensity of the corresponding fundamental using the photographic photometric method. The ratio of the integrated intensities of the fundamental and the overtone is found to be 3.9 in the case of CCl_4 and 7.5 in the case of $CHCl_3$.

43. Potential Constants of PCl_5 Molecule

V. SOMASUNDARAM, Annamalainagar

Eight force constants of PCl_5 molecule belonging to the point group D_{3h} have been evaluated using Wilson's F–G. matrix method. The constants thus obtained (in 10^5 dynes/cm) are $f_d = 2.024, f_{d'} = 1.177, f_{dd} = .1010, f_{dd} = .5710, f_\alpha = .4709, f_\beta = .4155, f_{d\alpha} = -.2$ and $f_{\beta\beta} = .0942$ where f_d and $f_{d'}$ are P–Cl′ and P–Cl′ stretching constants, f_α and f_β are Cl–P–Cl and Cl–P–Cl′ bending constants and all the others are interaction constants, Cl′ being the chlorine atom at the apex of the Pyramid.

44. Intensities of Raman Lines in Cresols

K. **Ramaswamy**, Annamalainagar

The Raman spectra of 0 and *m* cresols have been studied with special reference to the intensities of the various lines. The intensities of the corresponding lines in the two cresols have been compared and it has been observed that as the substance goes from the Ortho to the meta state, the lines at 540 cm^{-1} and 733 cm^{-1} show a decrease in intensity and the lines at 841 cm^{-1} and 1373 cm^{-1} show an increase in intensity. The lines at 1597 cm^{-1} and 1614 cm^{-1} do not show any change in intensity.

The OH band recorded in these laboratories by Krishna Pillai in both the cresols has been confirmed. A new band at 1440–1490 cm^{-1} has been recorded.

45. Infrared Spectra of Diethyl *n*-Alkyl Malonates, 3-15μ Region

K. **Nagaraja Rao** and A. B. **Biswas**, Poona.

The absorption spectra of ten, pure diethyl *n*-alkyl malonates, $[CH_3 . (CH_2)_n . CH(COOC_2H_5)_2$, where $n = 1$, 4-10, 13 and 17] have been measured in the rocksalt region of the infrared. Partial interpretations of some principal and characteristic absorption bands are attempted. The esterification of the *n*-alkyl malonic acids has resulted in marked changes in the absorption pattern. The two evident factors responsible for this significant changes are : the non-existence of the molecular interaction, namely the hydrogen bonding, and the presence of number of other isomers along with the most energetic isomer in the liquid phase. The broad and unsymmetrical band centred around about 1240 cm^{-1} and a strong band at 1033 cm^{-1} seem to be the characteristic of the esters. The absorption near about 725 cm^{-1} arising out of a $[CH_2]_n$ rocking mode suggests the existence of trans-zigzag configuration of the hydrocarbon chains as one of the stable configurations in the liquid esters. The absorption patterns have been compared with the corresponding acids and interesting correlations in the bands structure have been deduced.

46. Infrared Absorption Spectra of *n*-Alkyl Malonic Acids, 3 to 15μ Region

K. **Nagaraja Rao**, B. D. **Sharma** and A. B. **Biswas**, Poona

The infrared absorption spectra of *n*-alkyl malonic acids $[CH_3 . (CH_2)_m . CH . (COOH)_2$, where $m = 0$–11, 13, 15 and 17] as Nujol mulls have been examined between 3500 and 700 cm^{-1} using rocksalt optics, with a view to identifying the chief spectral features and other characteristics of the homologous series. A tentative spectro-structural correlation of some principal absorption bands has been attempted. The spectral features arising from intra- and inter-molecular interactions through hydrogen bonding in the crystalline acids have been compared with those where only one such type of interaction exists. The characteristic absorptions in the 2600-2700 cm^{-1} region and around 935 cm^{-1} suggest the presence of molecular association through hydrogen bonding. The $C = 0$ stretching frequency near 1700 cm^{-1} alternates characteristically between the odd and even members of the series and it seems possible to correlate this frequency with the melting point of the corresponding acid. A constant series of absorption bands in the 800-715 cm^{-1} region, caused by the $(CH_2)_n$ rocking mode indicates the existence of the methylene chains in the planar trans-zigzag configuration ; further the nonsplitting of this band suggests a triclinic packing for the hydrocarbon chains in the acid molecule.

47. The Infrared Absorption Spectrum of Crotonaldehyde

I. ACHYUTA RAO, V. SURYANARAYANA and V. RAMAKRISHNA RAO
Waltair.

The infrared absorption spectrum of a thin liquid film of Crotonaldehyde has been studied in the region $5-24^{\mu}$. A Leitz semi-automatic double beam infrared spectrograph with rock-salt and potassium bromide optics is used. The following absorption maxima are observed :

547(m)**, 667(vvw), 725(vvw), 848(vw), 904(vvw), 936(m)*, 972 (vs)**, 1012(vvw)*, 1046(vw)**, 1085(m)*, 1106(w), 1155(vs)*, 1232(vvw)**, 1259(vvw), 1311(vw)*, 1385 (vw)*, 1397(vw)**, 1451(s)*, 1637(w)** and 1689(vvs)** cm^{-1}.

Bands marked (*) are found to agree with Raman data[1] within 7 cm^{-1} and those marked (**) agree within 4 cm^{-1}. The C = O valence frequency is identified with the very strong band at 1689 cm^{-1}.

[1] Kohlrausch, K. W. F. 1934, *Z. Physik. Chem.* 27. 176.

48. On the Emission Spectrum of Anisole

I. S. SINGH and N. L. SINGH, Banaras.

The emission spectrum of anisole has been excited under critical conditions of excitation by transformer discharge through flowing vapour of the substance. The spectrum lies in the region 2747-3000 A° and consists of about 50 bands. The ground state frequencies observed are : 264, 440, 619, 789, 997, 1030, 1180, 1250 & 1300 cm^{-1}. The main frequency at 997 cm^{-1} is identified as corresponding to the 992 cm^{-1} 'breathing' vibration of benzene. Other totally as well as non-totally symmetric vibrations are superposed on this main frequency and its multiples.

49. Near Ultra-Violet Emission Spectrum of Mono Fluoro Benzene

N. L. SINGH and K. N. UPADHYA, Banaras

The emission spectrum of mono fluoro benzene has been obtained in an uncondensed transformer discharge through flowing vapour of a mixture of the substance and *n*-hexane mixed in the proportion 1 : 4. The spectrum has been photographed on a Hilger Medium and Large Quartz Spectrograph and lies in the region 2577–2988Å. In all 113 bands, degraded to longer wave side have been measured. A tentative analysis of the spectrum has been proposed. The ground state frequencies 517,810,825, and 1009 cm^{-1} have been observed to occur strongly. The 1009 cm^{-1} frequency forms a progression and four quanta of this have been observed. Upper state frequencies 965,910 and 778 cm^{-1} have also been observed with weak intensity.

50. On the Emission Spectrum of HgI

G. VENKATESWARLU and NAND LAL SINGH, Banaras.

The bands emitted by HgI in transformer discharge and in fluorescence have been grouped by earlier workers in seven systems. Herzberg has summarised the constants of this molecule but electronic transitions assigned to various systems are open to doubt.

These bands have been photographed on instruments with higher dispersion and resoluttion and the so-called C, D and E systems have been particularly studied. The present vibrational analysis shows that the unassigned E system forms a part of the D system. The previously designated C system and the present D system which comprises the old D and E systems involve a transition $^2\pi$ - $^2\varepsilon$ and are 3539 cm^{-1} apart equal to the doublet splitting of the $^2\pi$ level. No appreciable change in the constants of D system has been found. The new analysis will be presented.

51. The Electronic Transition Moment Variation in Bands of CN(violet system)

N. Sreedhara Murthy, V. M. Korwar and N. R. Tawde, Dharwar

The intensity distribution data of Ornstein and Brinkman on the bands of CN (violet) system has been used earlier by Nicholls to derive the variation of electronic transition moment $R_e(r)$ with internuclear distance r by the method of r-centroids. This study has been revised by the authors and it has been foundth at the variation of electronic transition moment is governed by the relation $R_e(r)$ = constant $(-1+1.634\ r)$ instead of $R_e(r)$ = constant $(-1+2.579r)$ given by Nicholls [Proc. Phys. Soc. (Lond.), 1956, **69**, 741].

52. Conditioning of Effective Vibrational Temperature of Band Systems by the Variation in Electronic Transition Moment

N. Sreedhara Murthy and N. R. Tawde, Dharwar

It is possible to correct the transition probabilities in band systems by taking into account the variation in electronic transition moment (e.t.m.). The effective vibrational temperature derived from the corrected data for the BeO ($B^1\Sigma \rightarrow X'\Sigma$) band system in carbon arc, gives a value lower than the one obtained under assumptions of constancy of e.t.m. The two values are respectively 4810°K and 4000°K. The difference in these values which is appreciable has been discussed critically.

53. Influence of Rare Gases on Molecular Spectra-Krypton in Nitrogen

D. R. Bagaikoti and N. R. Tawde, Dharwar.

This is an extension of Tawde and Desai's earlier work on Argon in Nitrogen, (1957, Proc. Nat. Inst. Sci. Vol. 23A No. 2 p. 119-129). The rare gas taken for the present investigation is Krypton. The spectrum of Nitrogen with its contiguous band systems-first positive and second positive, has been produced in a discharge containing mixtures of the two gases–Krypton and Nitrogen in varying proportions. The discharge conditions have been controlled for the partial pressures, total pressure and the discharge current.

The relative strengths of the two band systems, as well as the individual bands, were followed through quantitative intensity study. This revealed that the first positive system is relatively strengthened with increasing admixture of the rare gas Krypton a result in contrast with the one resulting from the influence of Argon. Among sequences, there is a general shift of intensity accent towards shorter wave-lengths. These findings have been discussed in the light of theoretical concepts.

54. Spectroscopic Study of Methyl Alcohol Flames

M. I. SAVADATTI and N. R. TAWDE, Dharwar

Methyl alcohol flames have been investigated spectroscopically at different air/fuel ratios. The inner cones of the flames in general contain the radicals C_2, CH, OH, CH_2O and CO where C_2 and CH are weak and CH_2O are continuous like in appearance (at low dispersion). The strength of each of the radicals C_2, CH, OH shows a regularity giving a definite rise and fall. With flames from just settled inner cones to blow-off stage the intensity maxima occur in the order C_2, CH and OH. The outer cones contain OH and CO only, the OH here following a similar course as in the inner cone.

Temperatures derived from the resolved rotational structure of OH bands in the inner cones show a definite maxima in the run over the whole extent of mixtures studied.

The line reversal temperatures obtained for the flames indicate a similar pattern.

These results on intensity and the temperature, both rotational and line-reversal, are being correlated.

55. Franck Condon Factors and *r*-Centroids for (AlO $(A^2\Sigma - X^2\Sigma)$ System

V. M. KORWAR and N. R. TAWDWE, Dharwar

The Franck Condon factors for AlO$(A^2\Sigma - X^2\Sigma)$ system have been evaluated by the method of numerical integration involving Morse oscillator by extending the author's work on this aspect (Science Abstracts 1957). Further the values of *r*-centroids for this system have been calculated by the same procedure and compared with those found graphically. It is intended to use the latter *i.e.*, *r*-centroids for obtaining the equation expressing the variation of R_e with r for the AlO system by employing the intensity values accurately determined from area under intensity contours of bands.

56. Some Quantitative Studies of Active Nitrogen

K. S. RAGHAVENDRA RAO and N. R. TAWDE, Dharwar.

Accurate measurements of the intensity of Active Nitrogen produced in a discharge tube of the type reported earlier (Ind. Sci. Cong., 1957, Abstracts, p. 32) have been carried out. The measuring equipment consisted of a photo-multiplier in conjunction with a stabilised power supply unit and a micro-ammeter. It was pretested for the linearity of response. Nitrogen was activated by a H. F. Discharge. A series of observations of a reproducible nature have been made on the after-glow intensity I which has been studied as a smooth function of the pressure p, applied voltage V and inter-electrode distance d. In particular, each of the (I, V) curves at various pressures has a peak intensity at I_{max} at a voltage characteristic of the pressure. I_{max} and p^3 have a linear relationship as expected by Rayleigh for a bimolecular reaction.

57. Absorption Spectra of Chloro-ethyl Acetate and Chloro-Formyl Ethyl Acetate

K. P. VERMA, Nainital

In the present investigation, the absorption spectra of formyl chloro-ethyl acetate have been studied in water, alcohol, ether, hydrochloric acid and caustic potash; and to get a better idea of the various bands, the absorption spectra of chloro-ethyl acetate have been studied in the same solvents.

The absorption of $—COOC_2H_5$ lies in the 204 mμ region. But in the case of chloro-ethyl acetate the absorption of $—COOC_2H_5$ undergoes a bathochromic displacement to 221 (in water), 228 (in alcohol), 230 (in *n*-hexane), 216 (in HCl) and 218 mμ (in KOH) region. By further substitution of one more hydrogen of chloro-ethyl acetate by —CHO radical, the absorption bands due to $—COOC_2H_5$ suffer a definite batho-chromic displacement from 204 mμ to 245 mμ region in all solvents and at the same time a weak absorption band appears in 320 mμ region. The intense absorption in 240 to 245 mμ region in all solvents supports the chemical observation that the compound is almost pure enol. This bathochromic displacement is due to electron repelling (OH) group attached to one end of the enol form.

The slight variation in the location of the K-band may be due to solvent effect, and the difference in the dielectric constant of the sovents. The variation in the intensity of K-band may be attributed to the solvent effect or chelation due to numerous isomers.

48. Apsorption Spectra of α-bromo Acetophenone, α-bromo α-formyl Acetophenone and *p*-Chloro α-formyl α-bromo Acetophenone

K. P. VERMA, Nainital

Absorption spectra of acetophenone have been studied by various workers. It exhibits three maxima (241, 278 and 320 mμ). α-formyl acetophenone is unsuitable as it undergoes self-condensation resulting in the formation of symmetrical tribenzoyl benzene. But α-bromo α-formyl acetophenone, which mostly exist in the enol form, is a stable compound. In the present investigation the absorbtion spectrum of the latter compound has been studied in *n*-hexane. It gave three maxima at 255, 285 and 320 mμ. Comparing with the absorption spectra of acetophenone, it appears that the introduction of a formyl radical has a bathochromic effect. To get a still better comparison, phenacyl bromide was studied. It gave four maxima at 222 250, 283 and 320 mμ. In this case a new band appears in the 222 mμ region.

In the case of α-bromo α-formyl *p*-chloro acetophenone, the absorption spectra gave three maxima at 255, 330 and 378 mμ. In this case there is no absorption band corresponding to phenyl radical. To explain the absence of absorption band due to phenyl radical in 280 mμ region, quinoid types of contributing structures have been suggested.

49. On the Electronic Spectra of Single Crystals of *p*-dichlorobenzene and *p*-dibromobenzene

S. C. SIRKAR and T. N. MISRA, Calcutta

The near ultraviolet absorption bands of thin single crystals of *p*-dichlorobenzene and *p*-dibromobenzene at −180°C have been studied with a view to finding out whether the bands due to two components with the light vector respectively parallel and perpendicular to the *b*-axis, are shifted appreciably from one another. A Hilger large quartz spectrograph has been used to photograph the two components simultaneously with the help of a double image prism of quartz. A fused silica lens was used to focus the transmitted light on the slit of the spectrograph.

It has been observed that in the case of *p*-dichlorobenzene the component with light vector parallel to the *b*-axis is absorbed more than that with light vector in the perpendicular direction and that there is no splitting of the two components. The splitting expected on Davydov's theory in the case of *p*-dichlorobenzene has been calculated and found to be about 22 cm^{-1}. As such a splitting is not observed there seems to be some discrepancy between the results expected from Davydov's theory and the experimental results.

In the case of *p*-dibromobenzene also no such splitting is observed.

60. Triplet Structure of Benzoquinone Bands

RAMA SHANKAR SINGH, Banaras.

The visible absorption bands of benzoquinone has some very peculiar features not found in the other two band-systems of the same compound in the ultra-violet region. This visible system known as n-π bands mostly consists of triple headed bands with separations of 5 cm^{-1} and 7 cm^{-1} lying on the shorter wave-length side of the main head. An attempt is made to understand this triplet structure as due to the space quantisation of the non-bonding *p*-electron of oxygen.

61. Electron Configurations and Energy Levels AlCl and Related Molecules

S. PADDI REDDY and P. TIRUVENGANNA RAO, Waltair

A recent study by the authors (1957) of the spectrum of aluminium monochloride in the Schumann region has led to the identification of six new excited electronic states of this molecule. A comparison of the term scheme of this molecule is made with those of the related molecules AlF, BF, CO and N_2 having the same number of outer electrons. This has shown that some of the obervod electronic states in AlCl are analogous to those of the other molecules. Probable electron configurations and term types responsible for the various excited levels in all the molecules are compared and discussed.

62. Origin of the Afterglow in Diphenyl

H. N. BOSE and M. L. BHAUMIK, Kharagpore

Measurement on the afterglow properties of diphenyl are reported. Diphenyl in polycrystalline form when excited by ultraviolet radiation emits a long period afterglow at liquid air temperaure. The afterglow decays exponentially and the decay time is temperature dependent. The intensity of the afterglow is found to be small when diphenyl is taken in the form of a single crystal. It is concluded from the results in this paper that the afterglow in diphenyl is due to defects in the crystal and not due to the triplet states.

63. Antistokes fluorescence in Urainium activated Boric Acid Glass

K. C. PANT and D. D. PANT Naini Tal.

Three antistokes bands have been observed at 4515, 4650 and 4785Ain Uranyl activated Boric acid glass. The intensities of these bands can be increased by preparing the samples at a higher temperatures than the melting point of Boric acid i.e. 185°C. Quantitative intensity measurements of the bands have been taken from 200°C to

−78°C. While there is a general quenching of intensity with increase of temperature, the relative intensity of the antistokes bands with respect to the normal Uranyl bands at 4920, 5150, 5400, 5660, and 5940A is found to increase. The increase is, however, smaller than expected on the Boltzman distribution law. The occurrence of these bands with relatively strong intensity as compared to that in pure solid, shows that the process of internal degradation of excess vibrational energy of the excited molecule is retarded.

64. A Case of Energy Transfer in the Fluorescence Spectra of Uranyl Solutions

D. P. KHANDELWAL and H. D. BIST, Naini Tal.

The fluorescence spectra of dilute uranyl solutions show bands due to uranyl-ion (α-bands) and those due to hydrolysed species (γ-bands). On continuous titration of a dilute solution with alkali the γ-bands increase relative to α. Studies on the relative intensities of the two series of bands at different stages show that the γ-bands become predominant in the solution even at a stage at which the hydrolysed species is present only to a small extent. One suggestion, besides others, is that this may be a case of energy transfer from the uranyl ion to the hydrolysed species, whose excited state is energetically lower by about .05 e.V. Evidence for this suggestion is obtained by observing the variations in the spectra between 0°C and 90°C. Lowering the temperature reduces the intensity of γ-bands relative to α, while corresponding absorption spectra show no material shift in the chemical equilibrium between the two species in this range. Hence the effect is obviously due to decrease in thermal agitation and increase in viscosity, both of which reduce the collision frequency and consequently inhibit energy transfer. Some other details in the spectra also support the existence of energy transfer.

65. Decay of Phosphorescence of Cas-Bi Phosphores

V. R. MADHAV RAO and D, R. BHAWLKAR, Sagar.

CaS -Bi-Phosphors were prepared using only anhydrous Sodium Sulphate as flux. The amount of flux was varied in steps of 5% of the amount of calcium sulphate taken and the decay curves obtained. The experimental results can be represented by the equation. $I_t = I_0 t^{-m}$, where the average value of m comes out to be 0.9. There is no systematic variation of m with the amount of flux. In addition to this result it was observed that the intensity of afterglow depends upon the amount of flux and from the curves obtained the intensity shows maximum values (*i*) for 15% and 40% of flux for the 2 hour heated samples and (*ii*) for 10%, 25% and 45% of flux for the 3 hour heated samples.

Crystal Structure

66. Space Group of 0-Tolidine

MD. A. QUADER, Calcutta

Earlier investigation (Clark & Pickett, 1931) on 0-Tolidine space group left it ambigous, either Q^3 or Q^4 depending upon the presence or absence of (*oko*) reflexion with *k* odd. In the present work it is re-examined by taking retation and Weissenberg photographs using CoK_α radiation. The crystal is orthorhombic with cell dimensions $a = 6.412$, $b = 7.490$ and $c = 23.758$ Å. Its density is found to be 1.234 gm/cm^3 and hence 4 molecules per unit cell. Systematic absences are : (*hoo*) when *h* is odd, (*ool*) when *l* is odd. Both the (010) and (050) reflexions in the '*a*' axis zero-layer Weissenberg photograph which, however, do not appear in the c-axis zero-layer photograph, are identified to be Reninger Spots, (010) being due to the pair (123, 133) and (050) due to the pairs (122, 132) and (203, 253). So (oko) with *k* odd are absent. No other systematic absences are observed. Hence the space group of 0-Tolindine is $P2_12_12_1(Q^4)$. Further work is in progress.

67. Renninger Effect in Naphthazarin

P. Srivastava, Calcutta

While studying the space group of Napthazarin, Renninger Effect has been observed in highly exposed zero-layer [010] Weissenberg photograph. This has been completely verified by construction of reciprocal lattice, and by calculation, and the space group of the crystal has been definitely established.

68. Atomic Coordinates in Kaolinite

G. B. Mitra and V. K. Malavya Sarma, Kharagpur

An extremely precise experimental determination of the structure factors due to the various planes of Kaolinite have been carried out. The intensities were compared with those of the (111), (200) and (220) reflections of spectro-scopically pure sample of Aluminium. The temperature factors of Kaolinite as well as Aluminium were determined by the statistical method. The absorption factors also were considered. The experimentally determined structure factors of the planes were found to agree satisfactorily with the 'B' coordinates of Gruner (1932) in the space group Cs^4.

69. The Banerjee Camera for Studying low Angle Scattering of X-Rays

G. B. Mitra, J. C. Maitra* and J. Ray, Kharagpur

A method of studying scattering of monochromatic X-rays at very small angles was developed by Banerjee and Maitra. In this communication, the details of a camera designed and constructed on this principle has been described. The monochromatising and reflecting single crystal is supported in a spacially designed holder and is capable of linear as well as angular movements. The collimating system consists of two very fine adjustable rectangular slits the distance between which can be varied. A third slit is used to eliminate scatterings from the second slit. The recording arrangement is a photographic film holder which can be replaced by a photomultiplier or counter device.

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70. Effect of X-ray Irradiation on the Electrical Conductivity of Pentahydrate Crystals of Sodium-thiosulphate

M. N. Verma and K. D. Prasad, Patna

During the insvestigations on the coloration produced in pentahydrate crystals of sodium thiosulphate, by X-ray irradiation, it was observed that the colour-centres produced by irradiation increase the electrical conductivity of the crystal. The increase in conductivity was found to depend on the number of colour-centres present per unit volume. When the coloured crystal is subjected to a steady electric field, the crystal is gradually bleached. As the bleaching progresses, the conductivity of the crystal diminishes correspondingly, until it reaches a final steady value. At this stage the crystal is also completely bleached. The steady final conductivity of the bleached crystal is the same as that before irradiation. The density of colour centres and their decay with time have been calculated. The density of colour-centres calculated from conductivity measurement agrees well with the density calculated from the measurement on the absorption band of the centre. An attempt has also been made to calculate the mobility of the colour-centres at the room temperature.

71. Lattice Dimensions and Space Group of Braunite

B. Mukherjee, Calcutta

Aminoff's crystal data of braunite ($3Mn_2O_3 . MnSiO_3$) are discussed with a different orientation, and a new space group I 4/m m m(D^{17}_{4h}) is assigned after indexing the powder pattern. The cell dimensions of tetragonal braunite are, $a = 9.40$Å, $c = 18.74$ Å, ($c : a = 1.994 : 1$), and the unit cell contains eight molecules. The definite existence of the powder line (130) excludes the possibility of the space group D^{20}_{4h} for braunite, as suggested by Aminoff, and the possibility of the presence of reflections (150), (053) and (039) can not also be ruled out.

72. On the Structure of Manganites

K. S. Irani, N. R. Sanjana, A. P. B. Sinha and A. B. Biswas
Poona

A review of the work on the structure of manganites, $A^{2+}Mn^{3+}_2O_4$, carried out at the National Chemical Laboratory is preseted. Eight compounds, with A = Cd^{2+}, Mn^{2+}, Mg^{2+}, Zn^{2+}, Co^{2+}, Fe^{2+}, Cu^{2+}, Ni^{2+}, have been studied. They belong to the two classes of spinels, viz., (i) tetragonal spinels, space group — $I4_1/amd$ — D^{19}_{4h}, $Z = 4$ and (ii) cubic spinels with space group Fd3m—O^7_h, $Z = 8$. The oxygen ion parameters and the cation distribution over the two types of sites have been determined. The observed symmetry and the cation distribution have been explained on the basis of quantum mechanical considerations relating to the *d* orbitals of the transition metals involved.

The effect of temperature on the distortion in tetragonal manganites has been studied by high temperature X-ray diffraction. The bulk crystal distortion has been attributed to depend on the statistical average fraction of the distorted octahedra aligned in the right orientation, while the transformation to the cubic symmetry is attributed to the complete randomisation of these octahedra.

The entropy of transformation was measured in each case by differential thermal analysis, and the values agree with those derived theoretically on the above model.

The cation distribution in the high temperature cubic form has also been obtained from X-ray diffractometer patterns and their variations are explained.

The effect of the removal of Mn^{3+} ions on the degree of distortion has been studied by preparing solid solutions of different tetragonal manganites with cubic spinels such as ferrites, aluminates and cubic manganites.

73. X-ray Study of $BaTiO_3$-$(La_{\frac{1}{2}}Li_{\frac{1}{2}})$ TiO_3 Systems

V. B. Tare, A. P. B. Sinha and A. B. Biswas,
Poona

Barium titanate and lanthanum lithium titanate $(La_{\frac{1}{2}}Li_{\frac{1}{2}})TiO_3$ were prepared by the solid state reaction between the respective oxides at 1300-1400°C. The crystal structure of the mixed phases was determined at various compositions by X-ray powder diffraction technique. Pure langhanum lithium titanate crystallises in cubic perovskite lattice with $a = 3.87$ Å and having La^{+++} and Li^{+} ions ditributed statistically over the Ca^{++} sites of $CaTiO_3$. Lathanum lithium titanate dissolves upto 8 mol. per cent of $BaTiO_3$; the lattice constants of the phases remain unchanged at 3.87 Å. In barium titanate rich phases, barium titanate dissolves lithium lanthanum titanate giving a homogeneous phase upto 50% of the latter. In this range the lattice constant decreases progressively from 4.01 Å for pure $BaTiO_3$ to 3.97 for 1 : 1 $BaTiO_3$ $-$ $(La_{\frac{1}{2}}Li_{\frac{1}{2}})_{\frac{1}{2}}TiO_3$. However, the tetragonal distortion responsible for the ferro-electricity of $BaTiO_3$ is destroyed on addition of more than 2 mol. per cent lanthanum lithium titanate. In the intermediate range of 8 mol. % $-$ 50 mol. % of BaTiO no homogeneous phase could be formed in samples heated upto 1400°C.

74. Site Preference Energy in Spinels

K. S. Irani, A. P. B. Sinha and A. B. Biswas, Poona

Using principles of statistical thermodynamics, a relation between the cation distribution in spinels and temperature has been deduced. For a cation distribution represented by the formula

$(A_{1-n}B_n)_{tet.}\ [A_nB_{2-n}]_{oct.}\ O_4$, n is given by

$$\frac{W}{kT} = \log \frac{(2-n)(1-n)}{n^2}$$

where W is the energy required to exchange a B ion at the octahedral site with an A ion at the tetrahedral site, and T is the temperature in °K. This gives a method of evaluating the hitherto undertermined parameter W, by simple high temperature X-ray diffraction techniques. The experimental results obtained for $MgMn_2O_4$ confirm the above deduction.

75. The Structure of Evaporated Sulphides of Zinc, Cadmium and Mercury

P. S. Aggarwal and A. Goswami, Poona

A detailed investigation has been made on the structures of ZnS, CdS and HgS layers deposited on (100), (110) and (111) faces of sodium chloride crystals at various temperatures. ZnS layers grew epitaxially on all the three faces of rocksalt both with parallel as well as {211} orientations, the latter being associated with intense twinned structures of the condensed deposits. The {211} orientated crystals were azimuthally rotated by 30°, 60° and 90° on (100) and (111) faces, but by 60° on the (111) face. The deposits of ZnS were mostly of cubic form at lower temperature range upto 200°C but developed both the hexagonal and cubic forms at an intermediate temperature range and finally only hexagonal structure at the substrate temperature of about 400°C. Both cadmium sulphide and mercury sulphide grew epitaxially on rocksalt sustrate but the former developed predominantly hexagonal structure and the later cubic only.

It was observed that whatever might have been the forms of the initial sulphides (cubic or hexagonal) the structure of the condensed deposits was determined by the substrate temperature alone.

76. Structure and Orientations of Halides formed on Copper Single Crystals

A. GOSWAMI, Poona

An electron diffraction study has been made on the structures of halides formed by the action of halogens on Cu (100), (111) and (110) faces at room temperatures. These halides crystals grew epitaxially on all the faces, even though their lattice parameters are widely different and later became randomly disposed and sometime also developed a preferred orientation. The size of these crystals also increased with the progressive reaction.

The halides were entirely cuprous type and had γ-form of structures (ZnS type). The extensive twinning on {111} planes observed, however, suggested that the β-form (h.c.p. type) might as well be formed as a result of twinning, but not due to thermal transformation.

77. Electron Microscope and Diffraction Studies of the Growth of WO_3 Microcrystals in the Colloidal State

S. N. CHATTERJEE, Calcutta

Studies on the growth and structure of the WO_3 microcrystals in the colloidal state were made with the help of the fine region electrion diffracton technique combined with the electron microscopy of the corresponding region. The electron microscope used was the Siemens' Elmiskop I. Structural changes of the WO_3 microcrystals in the colloidal state were revealed. It was found that the very small particles exhibited a new phase structure (cubic; $a = 14.05$Å) which disappeared with the growth of these particles with the attainment of the stable orthorhombic structure ($a = 7.28$ Å; $b = 7.48$ Å and $c = 3.82$ Å). The orthorhombic crystals were predominantly rectangular plate shaped with well developed (001) faces. A method was devised for the identification of the direction of the crystallographic axes in the micrographs of these crystals. These rectangular plate crystals were found to have maximum growth velocity along the b-axis resulting to bigger apparently hexagonal plate crystals. Electron diffraction from a single hexagonal crystal consisted of a cross grating pattern the analysis of which identified its basal plane to the (001) plane of the orthorhombic WO_3 crystal. Evidences of the growth from the rectangular to the hexagonal forms were obtained and discussed in detail.

78. Coprecipitation of Rare Earths with Calcium Sulphate

B. C. PURKAYASTHA and S. N. BHATTACHARYYA, Calcutta

Freshly precipitated calcium sulphate containing coprecipitated rare earths for about a few days, gives no constancy of the distribution factor. The uptake is, however, in agreement with Freundlich Adsorption Isotherm. Conclusion is arrived at that either the unstable orthorhombic form of gypsum or a higher unstable hydrate is first precipitated when calcium sulphate is formed by the addition of sulphuric acid to calcium chloride solution under the experimental conditions. The unstable calcium sulphate phase thus precipitated is finally transferred into the stable monoclinic gypsum ($CaSO_4$ $2H_2O$) which has been shown to take up rare earths through adsorption. Along with this study the uptake by two forms of anhydrous calcium sulphate (viz. natural anhydrite and soluble anhydrite formed respectively at 63.5° and 93°C) was also studied. It was found that both of these carry rare earths to an appreciable extent but the uptake is in agreement with Freundlich Adsorption Isotherm. The range of mixed crystal formation with the addition of inactive europium has been found out. It has been found that the unstable form of calcium sulphate forms mixed crystal with tracer rare earth upto the rare earth concentration of about 10^{-5} moles litre. When the concentration exceeds that limit, the uptake obeys the Adsorption Isotherm.

79. Diffusion of Radioactive Ions in Monocrystals of Potassium chloride

H. J. ARNIKAR, Varanasi

The Chemla technique was adopted to a study of the diffusion of the alkali ions sodium, potassium and cesium in monocrystals of KCl, studied by the aid of their radioisotopes ^{22}Na, ^{42}K and ^{137}Cs, used as tracers. A thin layer of the radioactive ion to be studied was deposited by sublimation on one face of the monocrystal of KCl cut to 12 × 12 × 2 mm, and two such crystals were bound with their active faces in contact. The system was placed in an electric furnace maintained at the constant desired temperature. At the end of a definite period the crystals were taken out of the furnace and sliced into layers of 3 microns by a microtome, the slices being collected in batches of 10 and the radioactivity of each determined. A repetition of the experiment with an electric field of the order of 20 volts/cm superimposed on the opposite faces of the crystal permits the measurement of the ionic mobility by the same technique. Results for the diffusion coefficients of $^{22}Na^+$, $^{42}K^+$ and $^{137}Cs^+$ in monocrystals of KCl in the temperature range 570–750°C and for the ionic mobilities of these ions for migration in KCl crystals at 710°C are presented. From the slope of the curve log *D*-vs-*1/T*, the corresponding energy of activation for diffusion is calculated. This last is nearly constant for the three ions, being 1,75eV ± 0.01. The mobility and diffusion results are considered from the point of the Einstein equation $v/D = Ze/kT$.

80. Diffusion and Electromigration of Radioactive Ions in Fused Salts— Part II Alkali Earth Ions

H. J. ARNIKAR, Varanasi

A technique is described for the study of zone electromigration and diffusion of anions and cations in fused salts supported on washed and calcined asbestos paper using radioisotopes as tracers. The ions whose mobilities are to be measured are deposited, together with their radioisotopes, in a narrow zone near to one end of a long band of treated asbestos paper (66 × 1,2 × 0,2 cm) impregnated with the fused salt (nitrate of sodium or potassium or their mixture). A potential of 600 volts is applied to the ends of the asbestos band dipping in Pyrex electrode cells also filled with the same fused salt. The entire assembly is maintained at constant desired temperature in a regulated electric furnace. The band is withdrawn from the furnace at the end of a definite period and the migration is determined by measuring with a special G.M. counter the *répartition* of the activity as a function of the distance from the origin. From this the mobility of the ion is calculated in relative units. A similar experiment but in the absence of the electric field permits the measurement of the diffusion coefficient of the ion in the given fused salt under the same conditions.

Applied successfully to a determination of the ionic mobility (v) and coefficient of diffusion (D) of alkali and halide ions in fused sodium nitrate, the above technique is extended in the present work to the alkali earth ions labelled by ^{45}Ca, ^{90}Sr and ^{131}Ba. The influence of ionic charge, mass and diametre are considered in explaining the markedly lower values of mobility of the bivalent ions. The verification of the Einstein equation $v/D = Ze/kT$ is not sufficiently precise in the present experiment to assume incomplete dissociation, or the presence of neutral particles which can diffuse without contributing to the electrical conductivity, in the case of these alkali earth salts.

Heat

81. A Study of Heat Transfer under Forced Convection

D. V. GOGATE, H. S. DESAI and G. V. ACHARYA, Baroda

This paper deals with the investigation of Heat-losses from spherical vessels under forced convection. After determining the values of the rate of fall of temperature $\frac{d\theta}{dt}$, of the spheres for different values of mean temperature θ, the total heat losses by the vessels were calculated at various temperatures and air-velocities. An attempt has been made to establish a quantitative relation between the Nusselt-Number and the Reynolds-Number on the basis of the experimental data obtained. Again it was observed that there was an abrupt change in the value of the amount of heat transfer when the Reynolds number approached the value of 10^5 as could be seen from the plot of Nusselt-Number against Reynolds-Number. An exactly similar change is found to take place when the drag coefficient of a sphere is plotted as a function of Reynolds-Number.

82. Thermal Conductivity and Eucken Correction for Diatomic Gases and Binary Gas Mixtures

B. N. SRIVASTAVA, Calcutta
and R. C. SRIVASTAVA, Lucknow

The thermal conductivities of pure oxygen, nitrogen and hydrogen gases and of the binary gas mixtures O_2–A, N_2–A and H_2–A at several concentrations have been measured by using a thick-wire conductivity cell at 38°C. These data have been used to calculate the Eucken factor for the diatomic gases and the binary gas mixtures. The experimental value of the thermal conductivity and the Eucken factor have been compared with the theoretical values obtained on the Lennard-Jones (12 : 6) model. Hirschfelder's recent expression for the thermal conductivity of polyatomic gas mixtures has also been tested at some length. It is found that Hirschfelder's expression is substantially correct in its dependence on the individual conductivities.

83. Dependence of the Thermal Diffusion Column Constants on the Law of Molecular Interaction

R. C. SRIVASTAVA, Lucknow

The theory of the thermal diffusion column for the nearly plane case, as developed by Furry and Jones, has been extended to take into account the temperature dependence of the elementary gas coefficients for a gas consisting of hard spherical molecules. The shape factors h, k_c and K_d have been obtained as power series in $\ln(r_2/r_1)$ and in terms of certain ratios of the two temperatures. It is found that h and k_c depend strongly on the law of molecular interaction for the gas.

84. Mutual Diffusion of Pairs of Rare Gases at Different Temperatures

B. N. SRIVASTAVA and K. P. SRIVASTAVA, Calcutta

The coefficient of mutual diffusion of the binary gas mixtures Ne-A, A-Kr and Ne-Kr has been determined at 0°, 15°, 30° and 45°C. Diffusion is allowed to take place between two diffusion bulbs through a precision capillary tube and samples of gas are withdrawn from one bulb at different times and analysed by a differential conductivity analyser. From the experimentally determined values of the diffusion coefficient at different temperatures the unlike interaction parameters for the above gas pairs have been calculated by two different methods on the Lennard-Jones 12 : 6 model. These values of the force parameters are found to be in good agreement with those obtained from the usual combination rules and also from the thermal diffusion data following the method of Srivastava and Madan. These values are found to reproduce very well the experimental data on mutual diffusion.

Using Kelvin's method, these data have also been utilised to calculate the self-diffusion coefficient of neon, argon and krypton.

85. Mutual Diffusion of Binary Mixtures of Helium Argon and Xenon at Different Temperatures

K. P. SRIVASTAVA, Calcutta

The coefficient of mutual diffusion of the binary gas mixtures A-He, A-Xe and He-Xe has been determined at 0°, 15°, 30° and 45°C by allowing the diffusion to take place between two bulbs through a precision capillary tube. A differential conductivity analyser has been used to analyse the samples of the gas withdrawn from one of the bulbs at different times. These experimentally determined diffusion coefficients have been utilised for calculating the unlike potential parameters ϵ_{12}/k and σ_{12} on the Lennard-Jones 12 : 6 model and compared with the values obtained previously from thermal diffusion data and also from the usual combination rules. The agreement seems to be quite satisfactory. These experimentally determined values of ε_{12}/ρ_2 and σ_{12} have been further used for calculating D_{12} and are found to reproduce the experimental data satisfactorily.

86. Force Parameters for the Buckingham-Corner Potential for Some Non-polar Molecules

A. K. Barua, Calcutta

Force parameters for the Buckingham-Corner potential have been calculated for Kr, Xe, CH_4, C_2H_4, H_2, He. For Kr, Xe, CH_4, crystal data, second virial data and the Joule-Thomson coefficient data have been used. Crystal data could not be used for C_2H_4, H_2, He. Quantum corrections have been applied to the lighter gases. It is found that a potential function with an exponential repulsion term cannot possibly give better fit with the Joule-Thomson coefficient data than the Lennard-Jones (12 : 6) potential. It is also found that either the second virial data or the Joule-Thomson coefficient data is unable to show the relative importance of the contributions of the r^{-6} and r^{-8} terms to the London attractive potential.

87. Anomalous Thermal Conduction in Certain Alloys at low Temperatures

M. S. Ramachandra Chari, New Delhi

Non-superconducting binary alloys of a noble metal containing a small amount of transitional metal as solute are known to exhibit anomalous behaviour. In particular, Gerritsen and Linde showed that when cooled down to liquid hydrogen temperatures and below, their residual electrical resistance exhibited a marked minimum and a subsequent maximum.

Thermal conductivity measurements by the present author (in collaboration with Dr. J. de Nobel at the Kamerlingh Onnes Laboratory, Leiden) on the alloys Ag-0.55% Mn, Ag-0.32% Mn and Ag-0.14% Mn, show an anomalous behaviour at liquid helium temperatures. If λ stands for the thermal conductivity at a temperature $T°K$, a plot of λ/T versus T presents a minimum and a subsequent maximum at a lower temperature.

Since one is tempted to correlate the two results, it should be pointed out that Gerritsen and Linde plotted the electrical *resistivity* on the Y-axis whereas we have plotted λ/T. Further, the shape of the λ versus T curves, and the fact that their shape remains practically unaltered in the strongest magnetic fields employed (viz. about 26 kilogauss), suggest that the anomaly should be attributed to an extra contribution to the lattice thermal conduction.

88. Lattice Thermal Conduction in Steels at Low Temperatures

M. S. Ramachandra Chari, New Delhi

The thermal conductivity of a series of nickel-steels containing respectively 2, 5, 11 and 20 per cent nickel, has been measured (in collaboration with Dr. J. de Nobel at the Kamerlingh Onnes Laboratory, Leiden) from liquid air temperatures down to liquid helium temperatures. An anomaly has been noticed at liquid helium temperatures, which could be attributed to an extra contribution to the lattice thermal conductivity.

Ignoring the small anomaly, the lattice thermal conductivity of these steels at liquid helium temperatures can be said to be limited principally by the scattering of the phonons by the conduction electrons. The coefficient of this scattering can then be estimated. As the temperature is raised to liquid hydrogen temperatures, the lattice thermal resistivity is caused also by impurity-scattering of the phonons, rather than by inter-phonon scattering.

The overall thermal conductivity, as well as the lattice thermal conductivity decreases with increase of nickel content, reaching a minimum at about 20—25% of nickel. This is found to be so whether one considers liquid air, liquid hydrogen or liquid helium temperatures.

Electronics

89. Directional Distribution of Sources of Atmospherics around Sangli

M. W. CHIPLONKAR and T. A. RAJU, Poona

With a view to studying the directional distribution of sources of Atmospherics, an instantaneous direction finding unit was designed, built and installed at Sangli early in 1957. The unit consists of three straight receivers tuned to 175 Kc/s band. Two square loop aerials of approximately two meters side are placed at right angles to one another feeding into two of the receivers and one vertical aerial feeding into the 3rd receiver for the determination. The directions of approach of Atmospherics are displayed on the screen of a C.R.O. Observations are taken four times during a day (at 0800, 1200, 1700 and 2100 hrs. I.S.T.) when a photographic record of two minutes' duration is taken on a continuously moving 35 mm. film. As a part of the I.G.Y. programme of the Poona University observations have been taken with this unit regularly from July, 1957 and in this paper the results of measurements extending over only the first ten months are presented and discussed.

The Atmospherics activity was judged from the number of atmospherics received per second from any direction and the maximum field strength received during the period of recording and was classified into Low, Moderate and Heavy types. The Heavy type of activity shows a directional distribution around the place of observation, peculiar to its geographical, position, viz., that (i) during the period of July, 1957 to May, 1958 on the average, the Heavy activity was located within the range of angles 70° (ENE) to 170°(SSE) approximately, which means that the land mass is more favourable than the ocean for the development of sources of Atmospherics. (ii) In general the activity is maximum during the months of April to June and a minimum in December. Further our observations show a fairly good agreement with the corresponding daily weather reports over a region of about 2000 kms. radius around Sangli.

90. Simultaneous Recording of Atmospherics on Four Frequency Bands in the Low Frequency Region

M. W. CHIPLONKAR and R. N. KAREKAR, Poona

In continuation of the work reported earlier (Jour. Atoms. & Terrestrial Physics, October, 1958, Vol. 10, in press) further work on the simultaneous recording of Atmospherics has been carried out in this laboratory. Atmospherics received separately on the four selected frequency bands, viz., 85, 125, 175 and 455 Kc/s are simultaneously recorded photographically for one minute at a fixed hour during each night. Thus in all 157 perfect photographic records have been obtained during the period 1st July, 1957 to 30th June, 1958. The results of measurements of intensity on these records have been statistically analysed and the following conclusions have been arrived at.

1. As previously observed by Chiplonkar and Athavale during the period March to June at Poona
   - (a) the Atmospherics activity is concentrated near about the frequency of 125 Kc/s. and
   - (b) the order of magnitude of peak field strength is 125, 175, 85 and 455 Kc/s.
2). However, during the period September to December (1957) this order of peak field strengths is interchanged in the case of 85 and 175 Kc/s bands only.
3). The variations of frequency of occurence with intensity are different during the local storm period from those during the undisturbed period and particularly so on 455 Kc/s band.

91. Height of the Night Airglow Emission Layer at Poona

M. W. Chiplonkar and P. V. Kulkarni, Poona.

With a view to determining the height of the night airglow emission layer in the tropics, measurements with a photoelectric photometer were carried out at Poona during the clear seasons of 1956 and 1957-58. The method of almucanter scanning was adopted for making the measurements of the whole dome of the sky and the Van Rhijn formula was used to estimate the height of layer. In all ten height determinations for six clear nights in 1956 and four clear nights in 1957-58, were made. The height determination was invariably based on a very large number of I_θ/I_z values during a single night where I_θ stands for the intensity of sky at a zenith angle θ and I_z is the intensity at the zenith. The values thus derived ranged from 165 km to 256 km with a weighted mean of 226 km for the first season and 217 km for the second season respectively. The results are compared and discussed with those obtained by other workers in higher latitudes.

92. Analysis of Some Fading Curves of Short-wave Radio Signal

O. P. Sinha, Patna

The phenomena of fading of radio-signals reflected from the ionosphere has not as yet been completely understood. Different pictures have been given regarding the constitution of the reflecting layer of the ionosphere. Some earlier workers observed that the random fading is of Rayleigh type, but recently some workers have found it to become Gaussian under certain conditions. The paper contains the results of the investigations made to study the fading curves on short-wave radio signals. The fading curves were continuously recorded with the help of a multiflex-galvanometer and a pen-recorder. A number of random type of fading curves have been analysed. While very few have been found to correspond to Reyleigh, more have been found totally with Gaussian, but a majority of the curves do not correspond to either. The periodic types of fading curves were also observed under conditions when they can not be due to interference between magneto-ionic components. They are, therefore, likely to be caused by interference of singly and doubly reflected waves. The nature of these curves suggests that the interfering waves themselves are not purely of random type. Thus it seems that the irregularities in the ionosphere are of a size larger than short-waves, and in such a case, the nature of fading curves is not likely to be either Gaussian or Rayleigh, but of some entirely different type caused by interference of several components reflected from the irregularities of the ionosphere.

93. Flutter-type Fading of Short-wave Radio Signals

P. M. DAS, Kharagpur.

Using a T-aerial, stable superheterodyne receiver and a recording type moving coil D.C. milliammeter of .5 seconds time period, the 41m band broadcast signals from AIR Calcutta were received at Kharagpur. The observations obtained on 26.3.58 and 28.3.58 are analysed in relation to flutter-type fading. It was observed that the fading was of predominantly random character on those days although at times quasi-periodic fading appeared for a short while. Flutter with quasi-frequency of the order of 2-5 c/s was superposed in the comparatively slower fading. It is indicated that a possible explanation of such fading may be obtained in terms of scattering from the ionospheric scatterers in accordance with the Doppler beat principle developed by Ratcliffe (1948), Booker and Gordon (1950), Khastgir & Das (1950) and Bailey (1952). If that principle is adopted and the scatterers are considered to exist at a height of 100 Km, then approximate calculation shows that the order of horizontal drift velocity of the scatterers that has to be assumed for explaining the order of fading observed should be from 50- 100 mps. which is rather high. If this horizontal drift can be identified with the ionospheric winds, then the winds thus speculated appear to be a little too high compared to the existing observations obtained elsewhere.

94. Noise Radiation from an Ozoniser Discharge

M. G. KELKAR, Amravati

Systematic observations of the r.f. noise spectrum emitted by an ozoniser discharge containing solid iodine in equilibrium with its vapour phase at room temperature are reported. It is observed that the r.f. noise radiation is continuous with two broad maxima at about 4 mc/s and 10 mc/s. The radiation is found to be pulse modulated and the modulation frequency corresponds with the frequency of the exciting a.c. voltage. The modulation is due to the first large current pulse in every half cycle of the intermittent electrodeless discharge.

A mechanism is suggested for the generation of strong noise in an electrodeless discharge. It is shown that due to intense ionisation caused by the first current pulse a reversed field region is produced and positive ion oscillations are possible during the existence of this pulse. These ionic oscillations, however, break up at random phases in different ions due to ionic collisions. The resultant radiation has thus the characteristics of noise.

95. Effect of Horizontal Movements in E_s Region on F_2 Region Drift Measurements

B. RAMACHANDRA RAO and E. BHAGIRATHA RAO, Waltair.

The extent of influence of the horizontal movements in a lower region on the dirft measurements of a higher region in the ionosphere has not yet been investigated. Using the spaced receiver method for the simultaneous study of drifts in the E_s and F_2 regions the authors have drawn the following conclusions. When records were taken on the same frequency such that partial reflections are obtained from E_s region, the drift measurements for the F_2 region are found to be predominantly influenced by E_s movements giving the same direction of drift for both the layers. If, however, F_2 drift measurements are made at a time when f_{Es} is sufficiently below the operating frequency, the dirft directions and magnitudes for both the layers are found to be different. Thus from a study of a large number of drift records taken at Waltair it is established that the operating frequency should be sufficiently higher than fE_s (at least by about 0.8 Mc/Sec) in order to see that the drift measurements on F_2 region are not vitiated by the E_s movements. Sample drift records showing the effect of E_s on F_2 fading are reproduced.

96. Behaviour of the F-layer from Three-spaced-receiver Records

S. R. Khastgir, Calcutta *and* RAM NOHAR SINGH, Banaras

The three-spaced-receiver fading records taken at Banaras with pulsed transmission at 3.8–4.2 Mc/s showed marked changes in the hour-to-hour and day-to-day observations. The paper describes typical fading patterns which, when analysed, reveal certain features regarding the behaviour of the F-layer. The following conclusions are drawn from the fading records taken simultaneously with the three receivers:

(i) A steady horizontal drift of the F-layer is indicated by a regular periodic fading pattern. The method of 'similar fades', as applied to the three records, gives the velocity and direction of the F-layer wind.

(ii) The records taken on the sixth day of the World Meteorological Interval (March 17 to March 26, 1958) reveal random fluctuations in signal amplitude which cannot be regarded as definitely due to the turbulence in the F-layer, as such random variations can be attributed to meteorological disturbances in the lower regions.

(iii) *Quasi*-periodic patterns consisting of irregular maxima and minima show that patches of higher electron density are formed at times in the F-layer moving in the horizontal direction.

(iv) Some records reveal maxima appearing at gradually decreasing time-intervals indicating the movement of a single ion-cloud having a contour with ionization falling off on either side of the maximum ionisation at the centre. The gradual decrease in the time-interval between successive maxim agives a measure of the ionization gradient.

(v) A few records show a reversal in the direction of the F-layer 'wind' as indicated by the sense of the time-shift.

(vi) The records taken a few minutes after the observed reversal in the direction of the F-layer wind change into random fluctuations both with regard to the signal amplitude and to the sense of the time-shift indicating turbulence in the layer.

97. Relaxation Time and Microwave Dielectric Loss of High Purity Shellac

S. S. **Srivastava**, Cochin

Microwave dielectric properties of high purity shellac has been measured from 100 cps to 10000 mc/s at room temperature. In radio frequency region measurements have been made by a Hartshorn and Ward type bridge. In 100 to 2000 mc/s region coaxial line technique has been used. In 3 cms and 8 mm bands wave guide test bench was assembled and the standing wave technique was adopted for measurements. Blonde is a high purity grade of shellac and is free from Rosin and Orpiment. The insoluble impurities are 0.1%. The tan δ-log f curve shows a broadened peak of dielectric loss; maximum loss occurring in the region 10^9 cps. The loss frequency curve shows a distribution of relaxation time and the variation of the dielectric loss conforms to the eqation

$$\tan \delta = 0.0435 \operatorname{Sech} \left(0.6 \log_e \frac{fm}{f} \right).$$

98. A Simple Equation for Estimating the Dipolement of a Molecule from Solution Data

Satish Chandra Srivastava and P. Charandas, Calcutta and Bombay

An emperical equation,

$$= (M_2)^{\frac{1}{2}} . A . \left(\frac{d \varepsilon_{12}}{dw_2} \right)$$

has been derived from an approximation of Guggenheim-Smith equation for oriental polarisation. μ is dipolemoment, M_3 is molecular weight of solute, A is constant for solvent, .09 for benzene, $\left(\frac{d \varepsilon_{12}}{dw_2} \right)$ is the slope of dielectric constant of solution weight fraction of solute, curve. The equation is useful for approximately estimating the dipolemoment of a solute only with dielectric constant measurement. It has also been shown that somewhat similar emperical equations for dipolemoment by Higasi and by Balkrishna and Srivastava, are the approximations of Guggenheim Smith equation, kept in a different form.

Miscellaneous

99. Ultrasonic Studies in Electrolytes Non-aqueous Solutions

Bh. Krishnamurty, Waltair

Ultrasonic velocities have been determined and hence adiabatic compressibilities have been calculated for eleven non-aqueous solutions at 29°C. The solvents are the methyl alcohol, ethyl alcohol, and n-butyl alcohol and also water. Since the inorganic salts are only sparingly soluble in alcohols, measurements are made at low concentrations of 0.0001 to 0.001 mole. The departures exhibited by these solutions from the theoretical laws derived from Debye-Huckel theory are explained as due to the incomplete dissociation of these salts in these solvents of low dielectric constants. It is found that in case of those salts which exhibited a departure, the concentration at which departure occurs is shifted to lower values in solvents of lower dielectric constants. In case of those salts that showed a linear variation, the gradients of the straight lines are less in solvents of lower dielectric constants.

100. A Wire Grating Ultrasonic interferometer

GOPALA MENON SREEKANTATH, Trivandrum

The phenomenon of successive diffraction of high frequency plane waves of sound in a liquid in an optical cell at two exactly similar parallel wire gratings immersed in the liquid is utilised in the design of an interferometer for the measurement of the wavelength λ^* of these waves. If Δ is the grating element, the sound beam emerging normally from the gratings undergoes variation in intensity which passes through maxima and minima for distances even and odd multiples of $Z = \frac{\Delta^2}{\lambda^*}$ between the two gratings and by findings these distances at which the intensity is minimum, the interval can be determined. The minimum intensity is almost zero if the diameter of the wire is $\frac{\Delta}{2}$. The well known Debye-Sears optical diffraction effect is made use of in determining these distances, the diffraction spectra produced by the acoustic grating disappearing when the intensity of the sound beam is minimum.

101. A Study of the Effect of High Elestrostatic Fields on the Optical Cosntants of Semitransparent Metalic Films

Y. G. NAIK and R. S. ADHAV, Ahmedabad

A study of the effects of high electrostatic fields of about 30,000 Volts on the optical constants n & k and reflectivity and transmittivity of semitransparent films of Iron, Nickel and Copper show no detectable change when light polarised at an azimuth of 45 is allowed to be transmitted or reflected by these films. The indications are that, with a photomultiplier tube as the detecting means and with the wavelength range 435 mμ to 630 mμ, no effects were observed upto potential gradients of 10^3 volts/cm.

102. Production of Joshi Effect in a Metal Electrode Discharge

V. G. KHER, Nagpur

A more searching study of the conditions of production of Joshi effect in an electrodeless discharge has indicated the possibility of production of this effect in a metal electrode discharge. It is shown that the essencial condition for the production of Joshi effect in metal electrode a.c. discharge is the limitation of the disharge current to a low value so that the discharge lies mostly in the sub-normal region of the current voltage characteristics. Such conditions can be produced in an a.c. metal electrode discharge by connecting a serial resistance (50k ohms) and a condenser (100 pf. or less). Under such circumstances wall charges exercise an effective control over the discharge.. These wall charges are affected by light and thus give rise to Joshi effect.

There is a considerable range of exciting voltages beyond threshold over which a positive Joshi effect is observed. There is also an appreciable time lag between the instant of irradiation and the observed positive or negative effect. A theory is developed that explains satisfactorily the more important features of this phenomenon.

105. "Cosmics" the Science of Spirit

S. V. Ramamurty, New Delhi

Cosmics is conceived as the Science of Spirit as Physics is the Science of Matter. The Cosmic Theory on which Cosmics is based is a mathematical theory of the Cosmos. The Cosmos is the Universe viewed as a unified field. The unity of the Cosmos is derived by me from the vision of Indian seers and thinkers whose vision and thought have been recorded in Vedanta, the philosophy of the Upanishads. The analysis of the Universe has been adopted by me from the Science of the West. In the Upanishads, the one-ness of universe is called *Brahman*. *Brahman* is there defined as "That from which all is derived, by which all is maintained and into which all is merged." The teacher asks the student to think over this definition and the student is led through various stages of *Brahman* from time, space, matter, mind to super-consciousness and Bliss. The English word nearest to *Brahman* is spirit. This tradition has been alive in India down to the present day when a leading statesman of India has expressed his belief in spirit as "the inner base of everything that exists."

The analysis of Science in the West yields time, space and matter as three fundamental entities of the universe. The conception of Einstein's four dimensional and spirit as fundamental entities of the universe but Physics has not accepted them as components of the universe which is its subject matter. Thus while philosophy and physics both deal with the universe, the former recognizes slao two fundamental entities—mind and spirit—which Physics does not recognize, confining itself to the three fundamental entities of time, space and matter.

There is need to reconcile philosophy and physics, if knowledge is not to be a house divided against itself. The way to find the one truth they both seek is not be reject the thought and experience of either but to integrate them both. It is in this belief that I have built up the Cosmic Theory as an integration of philosophy and physics. On this theory, the universe has five fundamental entities—spirit, mind, time, space and matter. Of these spirit is the basic entity, the inner self from which the other four are derived as the components of the outer self.

I first postulated arithmetical relations between time, space and matter as made up of atoms of the same basic stuff but of largely varying size. I then passed on to their being of different dimensions. Therefore, I deduced an exponential relation between spirit and the remaining four.

Mathematics has thus been the bridge between physics and philosophy. India invented the decimal system including the conception of one, ten and zero and also the relational numbers, positive and negative. Europe invented the imaginary number and transfinite number. All these forms are related to reality in different manifestations. Straight line, circle, atomicity all play a part in manifesting the one entity of spirit in the universe.

I have applied my theory both to Physics and Philosophy. I have depended for verification of my theory on the results of the application of both. My applications refer only to limited parts of the field. My theory does not contradict Physics in any manner but throws additional light on its results and fills up graphs. It also expressed the results of philosophy in a compact manner.

Along with the reality of spirit, my theory is also based on the reality of number. The difficulty in dealing with mind and spirit mathematically has been that an appropriate mathematical mechanism has not been found to deal with them just as time, space and matter are dealt with by the variables t, r and m. I attach the symbols μ (*mu*) and σ (*sigma*) to mind and spirit respectively. The one entity σ as observer observes the one entity σ as observed by $\frac{\sigma}{\sigma}$ *i.e.* a pure number. This agrees with the dictum of Indian philosophy that *Brahman* is both *anurupa* and *sankhyarupa*, *i.e.* spirit is both atom and number.

Take an entity θ . θ has both atomic quality and number. To dissociate the number from the quality, denote the number as σ . σ then is spirit. The simplest function of θ which is free from θ-ness is $\frac{d\theta}{\theta}$. As this is a number, I put down the following equation between spirit and entity, *viz.* $d\sigma$ varies as $\frac{d\theta}{\theta}$

i.e. θ varies as e^{σ}.

The three basic porpostions of Cosmics are thus:

1. Spirit and mind are real even as time, space and matter. σ, μ, t, r and m are the five fundamental entities.

2. The mathematical measure of spirit is pure number. Number is real.

3. The relation between σ, spirit and θ, any entity of the outer universe (including mind, time, space and matter) is given by $e^{\sigma} = \frac{\theta}{\theta_0}$, $\begin{matrix}\text{where} & \theta = \theta_0 \\ \text{when} & \sigma = 0\end{matrix}$

These three propositions give mathematical form to the intuitions of Indian philosophy regarding the universe of cognition. They are the contribution which cosmics claims to make to Science. They link philosophy with physics through mathematics.

I have so far described the basic approach of Cosmics. I then proceed to apply the basic propositions of Cosmics to some results in Physics and Philosophy. These applications may be examined if the basic approach is treated as worth consideration.

Instrumentation

104. Design of an Auxiliary Magnetic Drum Storage for Use with a Digital Computer

K. Bakhru, Bombay

The paper describes the mechanical details and the logical design of a magnetic drum memory. Various methods of representing binary digital information for storage on magnetic drums are reviewed with regard to their merits. A functional description of this drum memory is given using the 'Return to Zero' mode of representation. In

this mode each bit of information is represented on the surface of the drum by a spot magnetised to saturation in one direction and surrounded by a background field magnetised to saturation in the other direction.

The total capacity of the memory will be 8192 words of 40 binary digits each, recorded on a drum, 8 in in diameter and 12 in. long, rotating at a speed of about 3000 r.p.m. The storage section communicates internally and externally on a parallel mode, in which the 40 binary digits of a word are read or recorded at one time over as many separate tracks. The total number of tracks is 171 including the synchronising tracks and is divided into 4 groups. The average access time turns out to be about 10 mil. sec.

This storage will act as an auxiliary memory for the electronic digital computer being set up at the Tata Institute of Fundamental Research, Bombay. This machine has 1024 words of 40 binary digits each, as its fast random access memory in the shape of a 3 dimensional ferrite core matrix assembly.

105. A Simple Laboratory Purpose Multi-channel Pulse Height Analyser

A. K. SENGUPTA and R. BHATTACHARYYA, Calcutta

A simple ten-channel pulse height analyser has been designed and constructed utilising the discriminator, anti-coincidence principle. The instrument has been tested, and the overall performance has been found to be quite satisfactory. Design features include several diode discriminators in series, each followed by a trigger circuit. The anti-coincidences take place in simple resistive elements. The stability has been found to be excellent for runs over considerable lengths of time. The inherent simplicity of the analyser together with its suitability for use in coincidence experiments make it a useful instrument for laboratory work.

106. A Slow-motion Device for Longitudinal Movement of Grating Carriage in Eagle Mounting for Gratings of Large Radii of Curvatures

V. VENKATESWARA RAO and S. T. KRISHNA SWAMI CHETTY,
Waltair

Fine and accurately controlled longitudinal movement of a concave grating carriage over a length of 10 ft. can be obtained with a short screw of only 1 ft. in length out at one end of a long rod. Adopting the step by step micrometer principle a least-count of 0.0005″ for this translatory motion is attained with a possible accuracy of 0.00005″, by estimation, if required. This arrangement has been successfully used in the case of a 21 ft. concave grating spectrograph designed and constructed by the authors in Andhra University. With this device the grating can be set for different orders and regions of the spectrum quite easily and precisely. The usual arrangement of a long lead screw and an equally long graduated scale is dispensed with.

107. A New Method for Recording Melody Plot

H. V. MODAK, Poona

In the paper is described a new method for recording Melody plot, for which use is made of the Automatic Musical Instrument invented by the author.

The Automatic Musical Instrument is a stringed instrument which automatically plays musical accompaniment to vocal (or instrumental) music. It works on resonance principle. When notes are sung, the strings tuned to these notes vibrate and the desired accompaniment is obtained.

For recording Melody plot a number of small electric lamps, which correspond to the strings of the Automatic Musical Instrument are arranged in a row. It has been so arranged that when a string vibrates, the corresponding lamp glows. So in music when different notes are sung the lamps corresponding to these notes glow in the same sequence. A photographic record of these lamps obtained on a moving film gives Melody plot (Time variation of pitch). The method is relatively simple and gives better visual representation of music actually sung.

SECTION OF CHEMISTRY

President :—PROFESSOR SANTI RANJAN PALIT,
D.Sc., F.R.I.C., F.N.I.

Abstracts.

ANALYTICAL CHEMISTRY

1. Volumetric estimation of pentavalent vanadium with chromous salts.

J. P. TANDON, Agra and R. C. MEHROTRA, Gorakhpur.

It has been shown in the present investigations that ammonium metavanadate solution can be titrated directly against the chromous sulphate. N-phenylanthranilic acid, diphenylamine, diphenylbenzidine and diphenylamine sulphonic acid serve satisfactorily as internal indicators for the VO^{-}_{3} to VO^{++} change. It has been further demonstrated that ferric and cupric salts do not interfere in the above titrations. Mixtures of vanadate and dichromate or vanadate and ceric sulphate can also be titrated in the same manner using the very indicators.

2. Estimation of Bivalent Tin and Hexavalent Uranium with Chromous Sulphate.

J. P. TANDON, Agra and R. C. MEHROTRA, Gorakhpur.

The results described in the present communication show that stannous chloride and uranyl acetate can be estimated with the help of chromous sulphate. In the case of tin, excess of ferric iron is added and its excess found by titration with chromous sulphate, using neutral red or phenosafranine as indicator. In the case of uranyl acetate chromous salt titration, the above two indicators work satisfactorily in the absence of excess sulphuric acid, whereas methyl red and p-ethoxycrysodine give good end points even in the presence of excess of acid. In the alternative procedure for the estimation of uranium, chromous sulphate serves the purpose of Jone's reductor.

3. Spectrographic analysis of Lithium in Indian Micas.

B. DAS SARMA and MANOJ KUMAR MAJUMDER, Calcutta.

A rapid method for spectrographic analysis of Lithium in Indian mica has been developed. A number of mica samples containing varying Lithium contents (60—4000 ppm. Li—as found by Chemical concentration and determination in the flame photometer) were used as standards. Standards and unknown mica samples were each diluted with equal quantities of potassium chloride and taken in the cavity of specpure carbon anode. The cathode was also composed of a carbon electrode. The excitation was by 220 volts D.C. arc at 10 amperes. The exposure was for 2 minutes. Potassium chloride acted as a spectrographic buffer and intensified the lithium lines. Li 6707 was utilised for micas low in lithium and Li 3232 for those richer in lithium content. No internal standard was used. A step sector was used and intensity measurements were done by a non-recording Hilger Microphotometer. Results are reproducible and within 20%. It has been found that this method works much better than using artificially prepared standards. Rb was detected in samples rich in Li, but Cs only in the spectra from chemical concentrates.

4. Rapid geochemical method for determination of nickel in soil, laterite and other allied materials.

A. N. CHOWDHURY and B. DAS SARMA, Calcutta.

A new rapid method for estimation of nickel in soil, laterite and other allied materials has been developed. This colorimetric method utilises the wine red colour of the oxidised nickel dimethyl-glyoxime. But a significant variation in this method from the earlier ones utilising the same colour reaction is the absence of any oxidising agent. The colour is stable and the method is much more reproducible.

Sample is fused with potassium bisulphate and the melt is dissolved in dilute hydrochloric acid. In an aliquot of the solution nickel dimethyl-glyoxime is extracted by a mixed solvent of benzene and amylalcohol. The organic layer separated from aqueous layer, washed and shaken with a strong caustic alkali solution and some dimethyl-glyoxime. This step extracts nickel in the aqueous layer and develops a wine red colour tentatively by aerial oxidation, which is matched visually with standards.

Accuracy of this method is suitable for use in geochemical prospecting work. 30—40 estimations can be made in one man-day of 8 hours. With proper care this method can be applied to bauxite, iron ores and rock as well.

5. A new method for estimation of Nickel.

B. DAS SARMA and SADANANDA DAS, Calcutta.

A highly selective and sensitive method for the estimation of nickel in rocks and minerals has been worked out. Besides, the method is very rapid and inexpensive. The yellow colour produced by nickel dimethyl glyoxime in organic solvents has been utilised. The method consists of acid decomposition followed by suitable aliquots being extracted with the solvent (80% benzene, 20% isoamyl alcohol by volume) after complexing with citrate addition of dimethyl glyoxime and rendering the solution ammoniacal. The amount of solvent is such that not more than 10 γ of Ni is present per c.c. of solvent, as judged by absence of any red precipitate at the interface. The mixed solvent forms a clear layer very quickly and is freed from interfering elements like copper, cobalt etc. by two-three successive extractions wth 1 : 10 ammonia saturated with iso-amyl alcohol. Measurements were made at 360 $m\mu$ in the Beckman (model B) spectrophotometer. The method proved successful for all materials containing over 0·1% Ni sent for estimation in our laboratory.

6. A quantitative Spectro-chemical method for the analysis of Zirconia for low Hafnia content.

B. R. VENGSARKAR and R. K. DHUMWAD, Trombay.

A method is described for the determination of Hafnia over the range 0·0125 to 0·263%. The spectrograph employed has a reciprocal dispersion of about 4 A°/mm. at 2600A°, (Hilger E492). Excitation was by means of an intermittent A.C. arc with 230 V. and 6 amps. (Hilger Source Unit F.S. 110).

Oxides of the samples are adhered to on one of the flat ends of ¼" graphite electrodes by a drop of diluted "Durofix". Intensity ratios of the line pair Hf II 2641·406 A° and Zr II 2642·51 A° are obtained and used for plotting the working curve. Standard deviations calculated from a total of 30 observations, are, 6, 14 and 25% at 0·263, 0·0225 and 0·0125% Hafnia respectively.

7. Determination of Microgram quantities of Uranium in Thorium.

M. S. VARDE, Trombay.

Uranium present in micro amounts in thorium is extracted from the nitrate solution with 5% Tributylphosphate in kerosene. The extraction of thorium is prevented by complexing it with E.D.T.A. Calcium nitrate is used as a salting agent and the aqueous phase is adjusted to a pH of 2·5 before extraction. After scrubbing the organic phase with saturated ammonium nitrate (pH 2·5) the uranium is back extracted with ammonium carbonate and determined fluorimetrically. Thoria samples containing as low as 0·2 p.p.m. of uranium have been analysed.

8. Colorimetric determination of Boron in reactor materials by the Curcumin-trichloroacitic-acid method.

H. B. DESAI, M. S. PENDHARKAR and M. SANKAR DAS, Trombay.

The capture cross section of boron for thermal neutrons is high, so that it is necessary that reactor materials should not contain more than 1 p.p.m. of this element. This rigid purity control has necessitated on the development and standardisation of a colorimetric method for the determination of boron, based on its reaction with curcumin in presence of T.C.A.

Different methods are employed for the isolation of boron from different matrics. For the analysis of cokes, pitches and graphites, boron is first fixed as calcium borate and the boric acid isolated by the removal of cationic impurities on a cation exchange resin. In the case of uranium, thorium, metal or salts, boron is isolated by methylborate distillation. The final colorimetric procedure permits the determination of 0·04 p.p.m. of B in the final solution with an accuracy of 10%.

9. The separation of Thorium from Cerium and Lanthanum.

K. SINGH and D. PATNAIK, Cuttack.

The separation of thorium from cerium and lanthanum is involved at a certain stage of the extraction of thorium from monazite. For this purpose organic reagents are used which either extract or precipitate a compound of thorium in the pure state. We have used glacial acetic acid as the reagent for the separation of thorium by precipitation. The choice of glacial acetic acid has been made for the easy availability of this chemical at a low cost in our country and also for its easy recovery. By this method thorium has been separated from a mixture of thorium and cerium and from another mixture of thorium, cerium and lanthanum. Though due consideration has been given to both recovery and purity, yet stress has been laid on the latter to a greater degree.

10. Error involved in the estimation of Thorium by the Iodate method.

G. SAHOO, S. MISRA and D. PATNAIK, Cuttack.

The estimation of thorium by the iodate method is an established one. While working on the separation of thorium it was necessary to use a method as a standard one. The conversion of thorium nitrate to formate and subsequent ignition to oxide can easily be done in a platinum crucible. By this method and using spec-pure thorium nitrate (of Johnson Matthey & Co., England make) the thorium content in a fixed volume of a nitrate solution was determined. When this method of estimation was compared with the iodate method, it was found that there is a loss of thorium in the latter method. The loss occurs at the stage of precipitation of the iodate and also its washings. The percentage of this loss depends upon the quantity of thorium taken for estimation, the greater is the percentage of error the less the amount of thorium taken for estimation.

11. Separation of Uranium from Lanthanum and Sodium.

G. SAHOO, S. MISRA and D. PATNAIK, Cuttack.

Uranyl formate has got the unique property of undergoing photolysis resulting in the precipitation of hydrated uranium oxides whereas the formates of its accompanying elements such as, cerium, lanthanum, sodium and calcium etc. in the ore do not possess this property. This property can be utilised to separate uranium. Further, advantage can be taken of the solubility of the formates on account of the fact that, whereas the formate of uranium is fairly soluble in water, those of cerium and lanthanum are slightly soluble. In this communication the separation of uranium of 99·5 per cent purity has been carried out from mixtures of uranium with sodium and lanthanum without any loss of uranium in the process. The materials are cheap indigenous chemicals like nitric acid and formic acid and sunlight, the natural source of energy.

12. Glycolic titration of Acids and Acid mixtures.

CH. KALIDAS, Calcutta.

The acidic character of glycolic solvents has well been utilised for the titration of a number of weak bases, which cannot be titrated in water. Acidic solvents can also be used for the titration of acids and differential titration of acid mixtures since such solvents tend to exert a "differentiating effect" on these acids unlike basic solvents which exert a "levelling effect".

A number of acids, monobasic and dibasic, in Ethylene Glycol : isopropanol (1 :1) have been titrated against sodium glycollate in the same solvent. Thus it has been found that phthalic acid gives two well defined inflexions corresponding to its dibasic nature and phosphoric acid also gives two inflexions corresponding to its first two hydrogens, though the inflexions are weaker than those in water.

Using the information obtained regarding the relative strengths of acids from the titration curves, a few differential titrations of acid mixtures have been carried out.

Thus picric acid can be differentially titrated in presence of acetic, formic or citric acids. Also it is possible to titrate a mixture of phthalic and salicylic acids which gives two inflexions, the first one corresponding to half phthalic+salicylic acid while the second one corresponds to total neutralisation. A mixture of phthalic and sulphuric acids gives three inflexions, the first one corresponding to the first hydrogen of sulphuric acid, the second one corresponding to the second hydrogen of sulphuric+the first hydrogen of phthalic while the third one corresponds to the second hydrogen of phthalic acid.

13. Spectrophotometric Determination of Uranium with Nicotinamidoxime.

K. K. TRIPATHI and D. BANERJEA, Jadavpur.

Uranium (VI) has been found to give a yellow colour with nicotinamidoxime in alkaline medium which has been found to be highly satisfactory for the spectrophotometric estimation of the metal. The optimum pH for development of the colour is 10·9—11·5 in presence of a large excess of the reagent, at 15—40°C. The colour intensity is measured at 400 mμ. Sensitivity is 0·045 γ uranium/cm^2, with a visual identification limit of 5 γ uranium/ml. Beer's law is obeyed in the range of 5—40 p.p.m. of the metal with an optimum range of 8—40 p.p.m. The colour is stable for at least an hour.

All the common anions are without effect, excepting however phosphate, carbonate and cyanide which are tolerated only in traces. Use of tartrate or EDTA helps to mask effectively all the interfering cations excepting copper, iron and vanadium.

14. Spectrophotometric Determination of Cobalt with Nicotinamidoxime.

K. K. TRIPATHI and D. BANERJEA, Jadavpur.

Cobalt (II) gives a deep blue colour with nicotinamidoxime in alkaline aqueous-alcoholic medium which has been used for the spectro-photometric determination of the metal. The optimum pH for development of the colour is 9·8—11·3 in aqueous-alcoholic medium (40% v./v.) in presence of a large excess of the reagent, at 15—35°C. The colour intensity is measured at 580 mμ. Sensitivity is 0·01 γ cobalt/cm^2, while the visual identification limit is 0·5 γ cobalt/ml. Beer's law is obeyed in the range of 0·2—20 p.p.m. of cobalt, with an optimum range of 2—16 p.p.m. of the metal. The colour is stable for at least half an hour.

On account of the high pH and alcoholic medium used, most of the cations and anions interfere and, hence, must be removed. Use of citrate and tartrate helps to mask a few of the interfering cations.

15. Separation of Niobium and Tantalum with phenylarsonic acid.

A. K. MAJUMDAR AND A. K. MUKHERJEE, Calcutta.

A study on the effect of phenylarsonic acid for the estimation of niobium and tantalum indicates that the said reagent allows the estimation of tantalum from an ammonium oxalate solution, which contains either sulphuric acid to the extent of about 10% v/v or whose pH is maintained anywhere up to the maximum of about 5·8. Again for the complete precipitation of niobium the pH of the solution should be more than 4·8. A pH lower than 4·0 fails to precipitate niobium. The amount of ammonium oxalate in each case should not be more than 25 times the amount of the pentoxide, as a higher amount of the oxalate has a tendency to keep it in solution.

From a mixture of tantalum and niobium the former is first precipitated by the reagent from a solution maintained at a pH below 3·0, or preferably from an acid solution, and from the filtrate niobium is recovered by adjusting the pH to above 5·0. But when the ammonium oxalate is in excess, niobium is recovered by cupferron. When the ratio of Ta_2O_5 to Nb_2O_5 is higher than 1 :2, reprecipitation of the tantalum is necessary. Titanium, zirconium, lead, barium and strontium interfere with the determination of tantalum though, other ions have no effect in presence of complexone III.

16. Electro-chromatography in the separation of ions. Part VII. Separation of alkaline earth metals.

A. K. MAJUMDAR and B. R. SINGH, Calcutta.

Complete separation of ternary mixtures of ions of Ca, Mg and Sr or Ba with ammonium chloride and less complete but detectable separation of the same mixtures with ammonium nitrate have been achieved along with a few binary separations of the type Ca-Ba, Ca-Sr, Ca-Mg, Mg-Sr and Mg-Ba.

17. High frequency titration and estimation of ions—I. Determination of Silver.

A. K. MAJUMDAR and A. K. MUKHERJEE, Calcutta.

High frequency titration has been found to be a highly suitable technique for the volumetric estimation of silver with potassium chloride, potassium bromide, potassium iodide, ammonium thiocyanate, 2-mercaptobenzothiazole and bismuthiol II. The results have been found to be highly accurate when the amount of silver present was not more than 15 mg. Titration of potassium cyanide with silver nitrate gives an end point corresponding to the complex K $[Ag(CN)_2]$. Reverse titration fails to give any sharp break. Mercaptobenzimidazole bismuthiol I and potassium chromate are not suitable as reagents.

18. High frequency titration and estimation of ions—II. Determination of barium, lead, thallium, calcium, cerium, copper and silver.

A. K. MAJUMDAR and B. K. MITRA, Calcutta.

Solutions of potassium chromate, ammonium oxalate and ferrocyanide are used as titrants for the high frequency titration of metal ions. Lead and barium, up to 20 mg., and thallium, up to 50 mg., are estimated with chromate with good results. Similarly, ammonium oxalate behaves satisfactorily when the concentration of calcium is not more than 10 mg. and that of cerium is between 10 and 40 mg. Copper and silver can be titrated by ferrocyanide only up to a concentration of 10 and 20 mg., respectively. In all the cases, the pH of the solution should preferably be between 6·0 and 6·5, though it can be extended in some cases to even 5·0.

19. Amperometric estimation of Palladium.

M. M. CHAKRABARTTY, Calcutta.

In sodium acetate-acetic acid buffer the diffusion currents of palladium and of the reagents bismuthiol I, bismuthiol II, 2-mercaptobenzothiazole and 2-mercaptobenzimidazole remain constant respectively at potentials (vs S.C.E.) of $-0{\cdot}3$ to $-0{\cdot}8$V, 0·0 to $-0{\cdot}3$V, 0·0 to $-0{\cdot}8$V, 0·0 to $-0{\cdot}8$V, $-0{\cdot}4$ to $-0{\cdot}6$V and $-0{\cdot}2$ to $-0{\cdot}7$V. Bismuthiol I, at an applied potential of $-0{\cdot}3$V, is effective for the estimation of 1·2 to 2·5 mg. of palladium, whereas bismuthiol II and 2-mercaptobenzimidazole give highly satisfactory results with 1·2 to 6·0 mg. of palladium at a potential of $-0{\cdot}5$V. 2-mercaptobenzothiazole at the latter potential gives an error of about 5% when the concentration of palladium is about 6·0 mg.

20. Spectrophotometric Determination of Osmium with Anthranilic acid, Part I.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

Anthranilic acid has been bound to be a highly sensitive reagent for the spectrophotometric determination of quadrivalent, hexavalent and octavalent osmium at pH 6. The element in all the three valence states forms a dark violet coloured compound having the maximum absorbance at 400 mμ.

Quadrivalent osmium can be determined in presence of diverse ions using EDTA (disodium salt) as a masking agent. The optimum concentration range for the method is 2 to 6 p.p.m. of osmium where the per cent relative error per 1% absolute photometric error is 2·8.

Job's method of continuous variation, mole ratio and the slope ratio methods establish a 1 :1 complex between quadrivalent osmium and the reagent. Again, application of the mole ratio method to the reaction between osmium tetroxide or osmate (OsO_4^{-2}) and the reagent indicates oxidation of the reagent first and then the formation of a 1 :1 complex between the reduced osmium (IV) and the unoxidised excess reagent. The complex is stable in water and alcohol and has an average dissociation constant of $4\ 6 \times 10^{-5}$.

Part II : Sulphanilic acid as reagent Sulphanilic acid has been found to be a very effective reagent for the spectrophotometric determination of hexavalent and octavalent osmium at pH range 1·8—3·5. In these two valency states the element forms a dark-violet complex with the reagent having absorption maximum at 490 mμ.

As most of the ions interfere in the determination, the element must be separated as osmic acid by nitric acid distillation. Beer's law is obeyed with 0·5 to 9 p.p.m. of osmium (VIII) and 1 to 18 p.p.m. of osmium (VI) and optimum concentration ranges are to 2 to 8 p.p.m. for osmium (VIII) and 4 to 16 p.p.m. for osmium (VI). In these ranges, the per cent relative errors per 1% absolute photometric error are 3·02 for osmium (VIII) and 3·1 for osmium (VI).

Application of continuous variation and molar ratio methods indicate that in solution a 1 :2 complex is formed between hexavalent osmium and the reagent with an average dissociation constant of $1\ 2 \times 10^{-7}$.

21. Bismuthiol I as an Analytical Reagent. Estimation of Bismuth and Palladium.

M. M. CHAKRABARTTY, Calcutta.

Bismuth and palladium have been determined volumetrically after precipitation as bismuthiol I complexes. From 0·1N hydrochloric acid solutions they are separated from Fe^{+3}, Al, Cr, Ce^{+3}, Zr, Ti, Th, UO_2^{+2}, Be, Mg, Mn, Co, Ni, Zn, alkalis, alkaline and rare earths.

A mixture of tartrate or citrate and complexone III has been found to be useful for the separation of palladium at a pH 3·5—8·5 from As, Zn, Bi, Sr^{+4}, Sb, Fe^{+3}, Tl^{+1}, Cu^{+2}, Cd, Ce^{+4}, Pb, Ru^{+3}, Os^{+4}, Ir^{+4}, Rh^{+3}, VO_3^{-1}, CrO_4^{-2}, AsO_4^{-3}, WO_4^{-2}, PO_4^{-3}, MoO_4^{-2} and from all the other ions referred to above. Potassium iodide at pH 6·0—8·0 and thiosulphate at 6—7 keep Ag, Pb, Hg^{+2} and Au^{+2}, Ir^{+4}, Os^{+4} respectively in solution and thus allow a selective precipitation of palladium.

Hg^{+2}, Pb, Cu^{+2}, Ag, Tl^{+1}, Cd and Pd when present along with bismuth are first removed by the reagent and from the filtrate bismuth is estimated. Sn^{+2}, Sb^{+3}, Fe^{+3}, F^{-1} VO_3^{-1}, PO_4^{-3}, AsO_4^{-3} and CrO_4^{-2} interfere in bismuth determination while only Sn^{+2}, Pt^{+4} and CN^{-1} in palladium estimation.

22. Ultraviolet Spectrophotometric determination of Thorium with 2:4-Dichlorophenoxy acetic acid.

SACHINDRA KUMAR DATTA, Darjeeling.

Thorium salt of 2 :4-Dichlorophenoxy acetic acid is soluble in aqueous ammonium carbonate solution. The solution of this salt-like compound shows maximum absorbance at a wave length of 230 mμ and follows Beer's law. The spectrophotometric determination of thorium is based on the measurement of absorbance of this solution. The sensitivity of the method is 0·019 γ of thorium per cm^2 but the accuracy is poor in samples containing less than 2 mg. of thorium. The common metals do not interfere but strong interference is exhibited by iron, cerium (IV) and zirconium.

23. Spectrophotometric determination of Uranium with 1-Nitroso-2-hydroxy-3-naphthoic acid.

SACHINDRA KUMAR DATTA, Darjeeling.

1-Nitroso-2 hydroxy-3-naphthoic acid produces quantitative precipitations of cobalt, palladium, thorium, zirconium and uranium. In the present paper, this reagent has been employed for the spectrophotometric determination of uranium. Uranium is quantitatively precipitated from its solution with an aqueous 1% solution of this- reagent at pH 3·5 and the yellow uranium (VI)—complex is dissolved in 3M ammonia. This solution exhibits an absorption maximum at pH 10·4, which is the optimum pH for the determination of uranium by this method. Beer's law is obeyed between concentrations of 2 mg. to 80 mg. of uranium per litre and the practical limit of the sensitivity of the colour reaction is 0·5 γ per cm^2. But as only up to 4 mg. of uranium could be precipitated with this reagent from 50 ml. solution, it is not possible to estimate quantities less than 2 mg. per 25 ml. of samples by this procedure. The method is useful since most of the foreign elements can be separated from the uranium solution prior to its photometric determination.

24. Gravimetric determination of Uranium with Phenyl Glycine Ortho Carboxylic Acid.

SACHINDRA KUMAR DATTA, Darjeeling.

Phenylglycine-o-carboxylic acid forms quantitative precipitation with thorium, zirconium and uranium (IV). Here a method for the gravimetric determination of uranium has been described. The method is based on the reduction of uranyl ion to quadrivalent uranium and precipitation of the latter with the reagent. A greenish-white precipitate comes down from a uranium (IV) solution in presence of an excess of ammonium acetate and in the cold. A temperature between 5 and 10°C has been found suitable for the complete precipitation. The uranium (IV) salt of the reagent is unstable to heat, light and on keeping for a long time. The composition of the salt appears to be : $U(C_9H_8NO_4)_4$, but it is slightly variable and hence determination by direct weighing is not advisable. Ignition of the precipitate to U_3O_8 is essential. The reagent may be used for the determination of uranium in presence of either thorium or zirconium. Uranium and thorium or uranium and zirconium when present together in a mixture, may be co-determined, by adjustment of conditions.

25. Volumetric estimation of Thorium by Ferrocyanide.

MISS KAMALA ZUTSHI and JAGDISH N. GAUR, Jaipur.

Precipitation of $ThFe(CN)_6$ from a solution of thorium nitrate with potassium ferrocyanide at various concentrations has been carried out. The precipitate was filtered and the excess of ferrocyanide thus obtained was titrated against a standard solution of ceric sulphate. The amount of potassium ferrocyanide that reacted with thorium nitrate to form thorium ferrocyanide was calculated.

From the titration relationship in all cases the precipitate bears the composition $ThFe(CN)_6$. This is in agreement to our previous observations by the physico-chemical methods Gaur and Bhattacharya (Jour. Indian Chem. Soc., Vol. 31, No. 6, 1954). This provides a very correct method for estimating Thorium volumetrically.

26. Thiosalicylic Acid as a Colorimetric Reagent for Uranium.

BIMANESH SUR and AMIYA KUMAR CHAKRABURTTY, Calcutta.

Salicylic acid and its derivatives like salicylamide, salicylaldoxime, salicylamidoxime, salicylhydroxamic acid etc. have all been examined as colorimetric reagents for uranium (VI). Thiosalicylic acid in which the phenolic $-OH$ group of salicylic acid has been substituted by $-SH$ group has also been found to be a good colorimetric reagent for the element. The golden yellow colour whose absorption goes on increasing in the ultra-violet region can be measured at 400 $m\mu$ below which the reagent has got much absorption. The optical density at 400 $m\mu$ has been found to remain unchanged at the pH range 7 to 8·3. The colour system at this wavelength obeys Beer's Law. Using 2 c.c. of 1% alcoholic solution of the reagent up to 2 mg. of uranium in 50 c.c. can be estimated at 400 $m\mu$ against the reagent blank. The sensitivity of the reaction is 0·07 U/c.c. (Sandell) pD = 7·15. This compares favourably with the sensitivities of the other colorimetric reagents of uranium. But the reagent suffers from the same defects as those found with other salicylic acid derivatives in regard to interferences by diverse ions. Studies on the stability and nature of the coloured complex are in progress.

27. Estimation of Zr by m-ethyl phenoxy acetic acid.

A. B. SEN and MISS SARASWATI MISRA, Lucknow.

m-methyl phenoxy acetic acid has been prepared and used as a reagent for the estimation of *Zr* gravimetrically at different concentrations of free hydrochloric acid in the solution. When the concentration of free acid in solution is 0·12N—0·15N the precipitation is quantitative. When the concentration of free acid is more than 0·15N Zr is not quantitatively precipitated.

28. Spectrophotometric study of Gallium-Salicylic Acid Complex.

REBATI CH. DAS, R. K. NANDA and S. ADITYA, Cuttack.

The formation of the colourless complex between Gallium-perchlorate and Salicylic acid has been investigated by the ultraviolet spectrophotometric method. The study of the absorption spectra of the complex at different pH values show that the complex formation is maximum around pH 3·5. Job's method of continuous variation suggests that the complex possesses the composition having reactants in the ratio 1 :1. From this optical density measurements the stability constant of the complex at pH 3·4 and at different ionic strengths have been calculated. The values are $(3{\cdot}5 \pm 0{\cdot}4) \times 10^4$, $(1{\cdot}86 \pm 0{\cdot}18) \times 10^4$, $(1{\cdot}35 \pm 0{\cdot}13) \times 10^4$ and $(0{\cdot}902 \pm 0{\cdot}058) \times 10^4$ at ionic strengths 0·02, 0·05, 0·1, and 0·2 respectively.

29. Estimation of Albumin and Different Globulins in Antitoxin Serum by a Simple Micro-Kjeldahl Method.

S. K. DUTTA, Calcutta.

Antitoxin serum has been fractionated at different concentration of KH_2PO_4 in cold and filtered. The filtrates were analysed for nitrogen content, in order to estimate the precipitated albumin and the different globulins at different stages. This method is applicable to normal serum too. A comparative study of this method with the spectrophotometric method of Aull *et al* was carried out and they agreed well. An advantage of this method is that the non-protein nitrogen fraction of the serum can also be assessed.

30. Investigation on the chemical composition of hydrogen clays prepared from soils.

S. K. NANDI, Calcutta.

The chemical composition of hydrogen clays prepared from a number of typical Indian soils was determined. The SiO_2/Al_2O_3 and SiO_2/R_2O_3 ratios are well correlated with the base exchange capacity of the hydrogen clays. An appreciable quantity of potassium is present as a lattice constituent of the clays, showing the existence of micaceous clays. Potash content in Montmorillonite clay suggests that it is a beidellitic clay. Others are very likely a mixture of clays and contain illite as one of the constituents. Calculation of the lattice composition is possible only with one clay, which as X-ray analysis shows is a more or less pure clay mineral.

31. Nonaqueous Titration of weak bases using Chloracetic Acid medium.

D. RAMASWAMY and Y. NAYUDAMMA, Madras.

Several of the organic bases like diphenylamine, hexamethylene tetramine, urea, etc., are not titratable in glacial acetic acid acetic anhydride medium. The use of chloracetic acid however enables these bases to be titrated accurately with quite sharp inflexions. Chloracetic acid, however, has to be employed in presence of another solvent. In cases where acetic anhydride does not enter into reaction with the base within the duration of titration, a mixture of chloracetic acid—acetic anhydride in 1 :4 ratio was found to be ideal as a titrating solvent. In such a solvent hexamethylene tetramine and urea are titrated stoichiometrically corresponding to the formation of mono salts.

32. A New Colorimetric Method for the Standardization of Hypobromite.

G. S. DESHMUKH and S. V. TATWAWADI, Banaras.

The oxidation of ferrocyanide by hypobromite and the optical density of the yellow colour of ferricyanide thus developed has been studied using a Hilger

Spekker Absorptiometer Model H760. A violet filter having a maximum transmission in the range of 420-450 mμ was used. Series of experiments showed that quantitative oxidation of ferrocyanide occurred in the pH range 8-8·5 (bicarbonate buffer) and the curve obtained by plotting the optical density against the concentration of ferrocyanide may be used for standardization of hypobromite. The results compared favourably with those obtained by an amperometric titration of hypobromite against sodium arsenite as a primary standard.

33. Study on the Separation of Uranium and Iron (III) by Ion Exchange.

DEBABRATA SEN, Jadavpur.

A method for the separation of Iron (III) from U (VI) on anion exchange resin e.g. Amberlite IRA-400 has been worked out. In 10% sodium chloride solution it has been observed that ferric chloride is not absorbed on the resin column. Uranium (VI) on the other hand is retained on the column under the same experimental conditions, indicating the formation of uranyl chloro complex salt.

34. Analysis of Low Carbon contents in Steels.

V. RAMAKRISHNA, Jamshedpur.

A modified low pressure method has been described for the analysis of carbon less than 0·1% in steels. A single factor weight (2·729 g.) of the sample, or a fraction thereof, depending on the carbon content, is combusted with a flux in a stream of purified oxygen at 1150°—1250°C. The products of combustion, after passing through absorbers for SO_2 and H_2O, are condensed in a specially designed trap immersed in liquid air. The solidified CO_2 is subsequently evaporated into evacuated bulbs, whose volume has previously been calibrated. The resulting pressure of the gas gives a direct measure of the carbon content of the sample. Some typical results obtained for standard steel samples are presented and the precautions to be observed for reliable analyses are considered in detail.

35. Acid-base titrations in non-aqueous solvents with malachite green as an internal indicator.

SARJIT SINGH SANDHU and RAM CHAND PAUL, Dharwar.

Quite recently, the field of acid chlorides such as acetyl chloride, benzoyl chloride and phosphorus oxychloride has attracted the attention of various workers. Crystal violet and benzanthrone have been studied in these solvents. In this paper, the work carried out with malachite green as indicator has been described. Acid-base titrations in benzoyl chloride with malachite green as a means for detecting the end point provide quite interesting results. Lewis acids stannic chloride and titanium tetrachloride when titrated with bases such as quinoline, α-picoline and dimethyl aniline indicate the reversible behaviour of the indicator. However, in the case of thionyl chloride the indicator is destroyed and tolerable results are obtained only when the indicator is added near the approach of the end point. The results of these titrations afford a means of quantitative assessment of acids and bases in these media if the proper conditions are followed.

36. Colorimetric Studies in the Reduction of V^{+5} by Thiourea.

G. S. DESHMUKH and S. V. TATWAWADI, Banaras.

The reduction of pentavalent vanadium to V^{+4} stage by thiourea in HCl medium has been studied. The optical density of the blue colour of tetravalent vanadium solution was determined and its concentration was found out from a calibration curve obtained with standard solutions of vanadyl sulphate. 8 ml. of 1 M V^{+5} corresponds to 1 ml. of 1 M thiourea. The results have been adopted for the quantitative determination of vanadium.

37. Colorimetric Micro-Determination of Cyanide and Thiocyanate.

G. S. DESHMUKH and S. V. TATWAWADI, Banaras.

The intense yellow colour developed on treating a cyanide or thiocyanate solution with pyridine and sodium hypobromite in alkaline medium has been adopted for the colorimetric determination of CN^- or SCN^-. Using the Spekker Absorptiometer Model H760 and the violet filter (maximum transmission at 430 $m\mu$) microquantities of cyanide and thiocyanate were determined quantitatively by the above procedure. The method is specific and is not affected by common anions and cations which remain colourless on oxidation with hypobromite.

38. The Spectro-chemical Determination of Boron in Graphite.

A. P. D'SILVA, Bombay.

A spectrochemical method has been worked out for the estimation of trace amounts of B in graphite, in the range 0·25 p.p.m. to 4·0· p.p.m. B is first fixed in CaO by ashing a mixture of 800 mg. of graphite and 400 mg. of CaO (50 mg. of this is given by Calcium Sucrate). To this is added 0·4 ml. of a solution of cupric nitrate (75γ/ml.), to provide Cu as the internal standard. From this, 50 mg. pellets are made, and then arced at 12·0 amps., 220V, D.C. using a Hilger E492 large quartz spectrograph (Plate factor at 2500 A°, is 3 A°/mm.). The line pair employed is BI 2497·73 A°/CuI 2492·16 A°. The reproducibility expressed as the coefficient of variation is 18% at 0·25 p.p.m. and 10% above 0·5 p.p.m. The determination is affected by large amounts of Fe, Si, Cl and F.

39. Spectrographic Analysis of Rare Earths in Uranium and Thorium.

T. R. SARANATHAN, Bombay.

A method of spectrographic analysis of rare earths present in p.p.m. level in samples of uranium and thorium is described. From 50 gms. of original sample rare earths are separated chemically. 50γ of Ti, which is used as internal standard, is added to the rare earth oxides. This mixture is ground intimately with five parts by weight of graphite powder. A D.C. arc excitation is adopted with the charge on the anode used as the lower electrode. For each charge 6 mgms. are taken on the anode. The arc is operated at 10 amps. and 220 volts. The spectra are photographed on a large quartz spectrograph (Hilger E492) with a plate factor of about 7 A° per mm. at 3400 A°. TiI 3370·4 A° is used as the internal standard line for the five rare earths. The spectral lines of these rare earths used for analysis along with the detection limits and the % coefficient of variation are given in the paper.

40. Determination of Cationic Surface active agents in mixtures by nonaqueous Titration Technique.

D. RAMASWAMY and Y. NAYUDAMMA, Madras.

Organic salts and halogen acid salts of long chained nitrogen compounds can be titrated in nonaqueous medium by employing acetous titration in presence of mercuric acetate. A few industrial cationic fat liquors were titrated employing the method. However, methods are not available if amines and other anionic salts are present. Attempts have been made to titrate the cationic portion separately by removal of the anionics with the acid of a solvent by differential titration in chloracetic acid-acetic anhydride medium, by acetylation of the amino groups of the free amines and by treatment of the amines with benzaldehyde. The limitations of the method in presence of tertiary amines are discussed.

41. Determination of carbon in Metal Alkoxides.

R. K. MULTANI, Delhi.

In view of the rapid hydrolysis of metal alkoxides the results obtained by commercial micro-analysis for carbon and hydrogen were not always reliable. The analysis of carbon was therefore effected by Vanslyke apparatus. The alkoxide was digested for three minutes under reduced pressure in the oxidising medium. Carbondioxide was evolved quantitatively and absorbed in an alkaline solution. After ejection of unabsorbed oxygen and nitrogen, the alkali was neutralized and the pressure of the liberated carbondioxide was measured and from that the percentage of carbon was calculated.

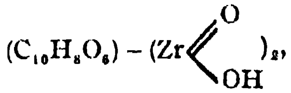
42. Analytical aspects of some organic acids : Part I. Gravimetric estimation of zirconium by o-phenylenedioxy-diacetic acid.

C. S. PANDE AND T. S. SRIVASTAVA, Lucknow.

o-phenylenedioxy-diacetic acid has been found to be a selective reagent for the estimation of zirconium. As little as 2·0 mg. of zirconia can be easily estimated with the help of this reagent. The composition of the precipitate varies somewhat with the temperature and, therefore, direct weighing is not possible. This difficulty is overcome by igniting the precipitate and weighing as oxide. $Be^{2}+$, $Ca^{2}+$, $Ba^{2}+$, $Zn^{2}+$, $Hg^{2}+$, $Al^{3}+$ $Ce^{3}+$, $UO_2^{2}+$, $Ti^{4}+$, $Th^{4}+$, $Mn^{2}+$, $Fe^{3}+$, $Co^{2}+$ and $Ni^{2}+$ ions do not interfere. Although $V_2O_2^{4}+$ and $Cr^{3}+$ ions are not precipitated with this reagent in neutral or slightly acidic solutions, when present alone but gets contaminated with zirconium precipitate, when these ions are present with the zirconium ions even up to 0·30N HCl concentration. The amount contaminated is so small that it is easily removed by double precipitation. This method yields satisfactory results even in the presence of small amount of $Fe^{3}+$ ions.

43. Analytical aspects of some organic acids : Part II. Gravimetric estimation of zirconium by m-phenylenedioxy-diacetic acid.

C. S. PANDE AND T. S. SRIVASTAVA, Lucknow.

In the previous part of this series, a method for the estimation of zirconium by using o-phenylenedioxy-diacetic acid has already been reported. The present communication deals with the use of m-phenylenedioxy-diacetic acid as a new reagent for the estimation of zirconium. The acid gives a flesh coloured curdy precipitate with zirconium ions in the presence of ammonium nitrate, which is quantitative up to 0·10N HNO_3.m-phenylenedioxy-diacetic acid has been found to be a selective reagent for the estimation of zirconium. Cu^{2+}, Be^{2+}, Mg^{2+}, Ca^{2+}, Zn^{2+}, Cd^{2+}, Pb^{2+}, UO_2^{2+} and Mn^{2+} ions are removed by single precipitation. Al^{3+}, Cr^{3+}, Fe^{3+}, Ce^{3+} and Ti^{4+} ions are removed by double precipitation. Sn^{2+}, Sn^{4+}, Th^{4+} and $V_2O_4^{4+}$ ions interfere in the estimation of zirconium with the help of this reagent. However, small quantities of Th^{4+} and $V_2O_4^{4+}$ ions are not interferable. Sulphuric and hydrochloric acids are not suitable media for the precipitation of zirconium. Chemical analysis of the compound shows the probable formula e.g.,  $(C_{10}H_8O_6)-(Zr\langle^{O}_{OH})_2$, for the zirconium compound formed with the acid.

44. Gravimetric determination of Thorium and Cerium with N-Benzoylphenylhydroxylamine.

S. C. SHOME, Calcutta.

Benzoylphenylhydroxylamine has been employed for the gravimetric determination of thorium and cerium. Thorium and trivalent cerium are precipitated separately with benzoylphenylhydroxylamine from their aqueous solutions and are then determined by igniting each precipitate to the corresponding metal dioxide. The ceric ions, which form a gelatinous precipitate with this organic reagent, are reduced with hydroxylamine hydrochloride before precipitating as cerous complex which is more granular in nature. The gravimetric separation of thorium and cerium is effected by making use of the finding that the thorium and cerous ions are precipitated with benzoylphenylhydroxylamine at pH values 5·0 and 6·5 respectively.

INORGANIC CHEMISTRY

45. Reactions of Ortho-esters of Titanium.

I. D. VARMA, Lucknow and R. C. MEHROTRA, Gorakhpur.

The step-wise reaction between isopropyl titanate and acetyl-bromide has been investigated in detail with a view to prepare, hitherto comparatively little known, bromide alkoxy derivatives of titanium. A convenient and easy method for the preparation of the compounds $(OPr^i)_{4-x}$ Ti Br_x has been described.

The reaction between phenol and ethyl or isopropyl titanate proceeds smoothly up to the formation of di-phenoxy derivative, further replacement of the alkyl group becomes slow and takes place only when the alcohol liberated in the reaction is continuously removed azeotropically. The compounds : $(OR)_{4-n}$ Ti $(OPh)_n$, (OR = OEt and OPr^i; n = 0 – 4) have thus been prepared. The molecular weights and boiling points of these compounds have also been recorded with a view to study the influence of aryl group on the structure of the ortho-esters of titanium, of the type : $(OR)_4$ Ti.

46. Organic compounds of Zirconium—Part VII. Study in zirconium Salicylates.

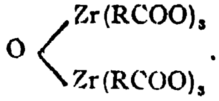
R. N. KAPOOR and R. C. MEHROTRA, Lucknow & Gorakhpur.

The reaction between zirconyl chloride and potassium salicylate in aqueous solution yields mainly zirconium mono-salicylate. The study of reactions between salicylic acid and zirconium tetrachloride and isopropoxide in benzene reveals that the carboxyl group is more reactive than the hydroxyl group which reacts only after the complete reaction of carboxylic group. The following new compounds of zirconium have been isolated: $Zr(OPr\text{-}iso)_2(OO.C_6H_4.O)$, $Zr(OOC.C_6H_4O)_2.Pr\text{-}isoOH$; $Zr(OOC.C_6H_4O)_2$ and $(OOC.C_6H_4.O)\ Zr\ (OOC.C_6H_4.OH)_2$.

47. Organic compounds of Zirconium—Part VI. Reactions of zirconium tetrachloride and isopropoxide with fatty acid.

R. N. KAPOOR and R. C. MEHROTRA, Lucknow & Gorakhpur.

The reactions of fatty acids with zirconium tetrachloride and isopropoxide have been studied. Whereas the former gives the tetra-carboxylate derivatives directly, the latter reactions yield only oxygen bridge tri-carboxylate derivatives,



$$O\left\langle\begin{matrix}Zr(RCOO)_3\\Zr(RCOO)_3\end{matrix}\right.$$

. The latter reactions have, therefore, been studied step-wise. It has been shown that the reactions are straightforward up to the formation of stable di-carboxylate derivatives. Side reactions start at this stage and a plausible mechanism has been suggested in confirmity with all observed facts.

48. Spectrophotometric studies on the stability and copper (II) and nickel (II) dimethyl- and diethyl-biguanide chelates in aqueous-alcohol medium.

ASIT KUMAR RAY, Calcutta.

The average values for the formation constants of copper mono-dimethyl and diethyl biguanide chelates are $1{\cdot}264\times10^{-3}$ and $6{\cdot}172\times10^{-5}$ and the same for the respective bis-complexes are $3{\cdot}59\times10^{-6}$ and $2{\cdot}89\times10^{-7}$ at 32° ± 2°C at an ionic strength of 0.1M KCl. The overall instability constants are given by $2{\cdot}009\times10^{-15}$ (Copper dimethyl biguanide) and $2{\cdot}447\times10^{-14}$ (Copper diethyl biguanide).

Studies on the variation of the absorption spectra of the corresponding nickel chelates with pH conclusively show that in each case only one complex species i.e. nickel bis-dimethyl or bis-diethyl biguanide is present in the solution within the pH range 8·5–10·0. The absorption maximum of these nickel chelates lies at 460 $m\mu$ characteristic of diamagnetic nickel complexes. For nickel bis-dimethyl and bis-diethyl biguanide systems the optimum pH for measurements was 8·5–9·0 and 10·5–11·0 respectively. The average values of the overall instability constants, determined at 32° ± 2°C and at an ionic strength of 0·1M KCl, are given by: $1{\cdot}239\times10^{-9}$ (Nickel dimethyl biguanide) and $1{\cdot}784\times10^{-8}$ (Nickel diethyl biguanide). These values agree fairly well with the values obtained by Ray and Das Sarma by Bjerrum's method.

49. Fatty acid derivatives of aluminium and titanium.

R. C. MEHROTRA, Gorakhpur.

Contrary to the conclusions of earlier workers, the mono-, di- and tri-soaps of aluminium have been shown to be definite chemical entities and simple methods of preparation for each class have been described by the reaction between aluminium alkoxide and the corresponding fatty acid in the required molar ratio.

The work has been extended to similar derivatives of titanium. The reaction between titanium alkoxides and fatty acids has been shown to be straight-forward up to the formation of di-carboxylate derivatives after which side-reactions set in resulting in the formation of titanyl dicarboxylate and oxygen bridge titanium tri-carboxylate derivatives. The reactions have been studied in detail and a simple plausible mechanism has been suggested.

The work is being extended to derivatives of zirconium and thorium also.

50. Adsorption of Carbon Monoxide by Iron.

K. S. NARAYAN, V. SRINIVASAN and K. R. KRISHNASWAMI, Bangalore.

The adsorption of CO by iron results in the formation of iron pentacarbonyl in the temperature range of −40 to 53°C. But between 97°C and 200°C CO does not react with iron to form a carbonyl but undergoes catalytic conversion to CO_2. The rate of this catalytic conversion increases with increase in the temperature of adsorption.

The results on the adsorption of CO by iron in the temperature range of −40°C to 200°C cannot be interpreted on the basis of a chemisorption process.

51. Catalytic decomposition of potassium chlorate in the presence of a mixture of catalysts and Determination of the temperature coefficients of the decomposition.

L. M. APTE and P. S. JAVADEKAR, Sangli.

Mixtures of Vanadium chloride with the Sulphates of (1) Iron (ferrous), (2) Nickel, (3) Manganese, as Catalysts are used to decompose potassium chlorate and the reactions are investigated. It is found that the mixture of catalysts with vanadium as one component acts less effectively than the individual components of the mixture when each acts alone.

The Temperature coefficients of the decomposition are also determined.

52. Complex compounds of cobalt (II) with o-phenylene biguanide and their magnetic susceptibility.

S. P. GHOSH and A. K. BANERJEE, Patna.

Several complex compounds of bivalent cobalt viz. cobaltous bis o-phenylene biguanidinium chloride, bromide, iodide, sulphate and nitrate have been prepared and their properties studied. These complexes have been found to be quite stable even when moist and are strongly paramagnetic. The colour of the salts is generally brown and these are all insoluble in water. The magnetic moment of these compounds lie between 4 and 5 B.M. (uncorrected). From the magnetic property these compounds have been suggested to have a tetrahedral 4s $4p^3$ configuration.

53. Ion Exchange Behaviour of Uranium.

ANIL K. DE, Calcutta.

Systematic studies of cation exchange behaviour of uranium have been undertaken using Amberlite IR-120 (H+−form). Various acid eluants, including HCl, H_2SO_4, $HClO_4$, of different concentrations have been investigated. Essentially quantitative elution of uranium from the resin bed has been achieved using 200-250 ml. of HCl (2N, 4N) or H_2SO_4 (2N, 4N). HCl and H_2SO_4 give similar elution curves with peaks at similar positions and therefore, the elution constants are the same in these systems.

54. Potentiometric study of Sulphosalicylic Acid metal chelates.

N. S. KUNTE, Trombay.

The formation of sulphosalicylic acid (SSA) metal chelates has been studied potentiometrically. The OH group in the SSA molecule has a pK value of 11·2. When SSA is in combination with a metal, it is neutralised at a much earlier pH, as shown by the potentiometric titration curves of SSA—metal ion solutions. The negative charge on the SSA—metal chelate also increases by one.

Beryllium being a divalent ion, forms a neutral complex first and at the pH when OH group is neutralised, forms an anionic complex. This is supported by the fact that Be-SSA complex at pH 6 0 is adsorbed by an anion exchanger. Rare earths, being trivalent, form a cationic complex at pH 4·0 and a neutral complex at pH 7 0. This is supported by the adsorption of SSA - Rare Earth chelate on a cation exchanger at pH 4·5 and not at pH 7·0.

Thorium apparently does not form a complex with SSA.

55. Spectrophotometric studies on the stability of nickel-paludrine chelate in 50% aqueous alcohol.

ASIT KUMAR RAY and MANOJ M. RAY, Jadavpur.

Studies on the variation of the absorption spectra of nickel-paludrine system with pH conclusively show that only one complex species i.e. nickel bis-paludrine is present in solution. The instability constant of nickel bis-paludrine chelate has been determined photometrically, assuming that its formation is a one-step reaction. The absorption maximum of nickel bis-paludrine lies at 460 mμ characteristic of diamagnetic nickel complexes. The molar extinction coefficient of the complex at 460 mμ (116·16) has been calculated from the maximum optical density of solutions containing nickel ion and excess paludrine above pH 8, where the formation of the chelate is complete. The average value of the overall instability constant, calculated from the optical densities of the equilibrium solutions at 460 mμ is $1{\cdot}838 \times 10^{-10}$ (32° ± 2°C) at an ionic strength of 0·1M KCl, which is more or less in accord with the value $8{\cdot}318 \times 10^{-10}$ (32°C) obtained by Rây and Das Sarma by Bjerrum's method.

56. Multinuclear nitro-derivatives of Cobalt Double cyanide complexes.

H. P. AGARWAL and N. THANKARAJAN, Bhopal.

The sequence in which the reactants are added probably does not change the nature of the complex studies. On the other hand the proportion of the reactants is very important. By altering the ratio of the reacting substances, three different complexes namely $K_4\ CO_2(CN)_9\ NO_2$, $K_4\ CO_2(CN)_8(NO_2)_2$ and $K_4CO_2(CN)_7\ (NO_2)_3$ were prepared. It is hoped that by increasing the proportion of sodium nitrite (if necessary of acetic acid also) other multinuclear nitro-derivatives may be prepared.

57. Chemistry of Monofluochlorates : Part I.

ASIM BIKASH RAY and GRIHAPATI MITRA, Calcutta.

The monofluochlorates of copper, nickel, zinc, cobalt and cadmium have been described. The copper salt was found to crystallise with five molecules of water while the cadmium salt retained 8/3 molecules of water as water of crystallisation.

The other compounds crystallised with seven and six molecules of water. These compounds were all highly soluble in water. The powder picture of the nickel salt has revealed that this compound is not isomorphous with the corresponding sulphate. All these monofluochlorates, however formed mixed crystals with the corresponding sulphates. The conductivity of the zinc salt at different dilutions were measured and it was concluded that there were only two ions in solution. Addition of calcium chloride solution to the solution of these compounds did not result in immediate precipitation of the fluoride of calcium. It was found that even at a higher temperature the precipitation was not quantitative.

58. Nitroso-derivatives of Cobalt double cyanide complexes.

H. P. AGARWAL and N. THANKARAJAN, Bhopal.

Nitroso-derivatives of Cobalt double cyanide which are analogous to those of its congeners, specially those of iron and Manganese have been prepared. One of them is potassium penta-cyano-nitroso cobaltate II, which is a true cobalt analogue of nitroprusside and the other is $K_4Co(Cn)_5NO$ analoguous to $K_3Mn(CN)_5NO$ and $K_3Fe(CN)_5NO$.

59. Pyridinium Ceric Chloride complex.

S. S. MOOSATH and M. R. A. RAO, Bangalore.

Pyridinium ceric chloride ($CeCl_4 2C_5H_5NHCl$) can be prepared by the interaction of hexachloroceric acid with pyridinium hydrochloride in methyl alcohol solutions. The analysis of the compound confirms the formula given above. Spectrophotometric measurements indicate the presence of ceric chloride in the complex. Vapour pressure measurements on the compound reveals that the compound decomposes when heated above 30°C. Attempts to prepare the sodium and ammonium salts of hexachloroceric acid did not give any fruitful results.

60. Ammino-biguanido Cobalt (III) complexes.

MANOJ MOHAN RAY, Calcutta.

A series of cobalt (III) complexes with mixed ligands, amines and biguanides, has been prepared by the oxidation of cobalt (II) bis-biguanide or cobalt (II) ethylenedibiguanide sulphate by air or hydrogen peroxide in presence of ammonia and amines which include methylamine, ethylamine, n-propylamine and benzylamine. One mixed pyridine-ethylenedibiguanide complex has also been isolated. The ease of formation of these complexes as well as their stability have been found to decrease with the increasing size or mass of the base. The ethanolamine and n-butylamine complexes are too soluble to crystallise out. The secondary amines show a weaker co-ordinating ability and leads to the disproportionation of the cobalt (II) bis-biguanide sulphate into cobalt (III) tris-biguanide complex and cobaltic hydroxide. The bis-ammino ethylenedibiguanide complexes exhibit an interesting reversible colour change in solution possibly due to reversible aquation of the complex. These complexes with mixed ligands are assumed to have trans-structure in view of the fact that the original cobaltous complexes have square planar configuration as indicated by their magnetic susceptibility values.

61. Citrate complexes of Zinc.

RABINDRA K. PATTNAIK and S. PANI, Sambalpur.

Citrate complexes of divalent zinc have been studied by different pH titration and conductivity titrations between pH 2·5 to 6·8. The neutral complex formed at below pH from zinc ion and citric acid with liberation of two protons, behaves as a dibasic acid and dissociates into two steps. The equilibrium constants of the reactions are $6{\cdot}36 \times 10^{-5}$, $4{\cdot}89 \times 10^{-5}$ and $2{\cdot}11 \times 10^{-8}$ respectively.

Two of the COOH groups of the citrate ligand are involved in forming the complex. The hydroxyl group reacts, but the proton is not liberated. The possible structures of the complexes have been suggested.

62. Phthalic acid salts of Titanium.

M. ZAFAR JAMIL and S. M. FAZLUR RAHMAN, Aligarh.

A survey of the literature shows that very little work has been done on the phthalic acid complexes of titanium. A study of the complexes formed between the potassium salts of acid and Ti (III) and (IV) was taken up. Two complexes of Ti (IV) were obtained by mixing 20 c.c. of N/5 $TiCl_4$ soln. and 40 c.c. of N/5 potassium hydrogen phthalate soln. or 22 c.c. of N/5 potassium phthalate soln. The white precipitate was washed with doubly distilled water and analysed. On determining the percentage of Titanium in the complex, the probable composition can be given as :—

$$Ti\ (C_8H_4O_4)_4$$
$$Ti\ (C_8H_4O_4)_2$$

Considerable difficulty was encountered while preparing the complexes of Ti (III) with potassium phthalates. Special device was used to reduce Ti (IV) to Ti (III) and an inert atmosphere was maintained when the two reactants were mixed. Brown precipitates was obtained. These however could not be isolated because during washing the whole thing dispersed (some proof of the fact that oxidation was taking place). Further work is in progress on these lines.

63. Studies on bipositive silver complexes.

BIRESWAR BANERJEE, Calcutta.

In continuation of the previous works on bipositive silver complexes, it has now been possible to stabilise Ag^{II} by complex formation with β picoline. The argentic complex of β picoline has been prepared by the persulphate oxidation of silver nitrate in the presence of an excess of the ligand. To neutralise the acid liberated in the oxidation reaction some $NaHCO_3$ should be added in the reaction mixture. The product forms orange yellow crystals, liberates iodine from an acid solution of KI and decomposes when treated with acids and alkalies. It is quite stable in cold when kept inside a vacuum desiccator. The composition of this complex is given by $[Ag^{II}(C_6H_7N)_4]S_2O_8$.

Attempts for the preparation of argentic complexes with γ picoline has yielded a similar complex which is now under examination. α Picoline under similar conditions gives an orange-yellow solution from which it has not yet been possible to isolate any complex silver compound. This is possibly due to the presence of CH_3-group in the α-position, exercising what is known as hyperconjugation effect.

64. Chemical analysis of dialised product obtained by the reduction of Molybdic Acid.

NASEER AHMAD and S. M. FAZLUR RAHMAN, Aligarh.

On the basis of the data available on the composition of molybdenum blue it appears that it is influenced by (I) the nature of the reducing agent used and (II) the mode of extraction. In our view the use of organic reagents for reduction and subsequent extraction of the compound involved difficulties. Hence reducing agents like $FeSO_4$, Cu_2Cl_2, KI and $SnCl_2$ were used and a new method based on the dialysis of the reduced product was employed for extraction.

The four samples obtained were found to have the approximate empirical formula Mo_3O_8, XH_2O. The amount of water changed with the reducing agents used and also when different samples by the same reducing agents were prepared. With Ferrous Sulphate and potassium iodide, the amount of water ranges from one molecule to three molecules per mole of Mo_3O_8 while in the case of stannous chloride and cuprous chloride, it ranges from three to six molecules. To get better insight into the diversity of results samples collected at different stages of dialysis with the same reducing agent would be analysed.

65. Spectrophotometric study of Gallium-Sulphosalicylic Acid complex.

R. K. NANDA and S. ADITYA, Cuttack.

The complex formed between Gallium Perchlorate and Sulphosalicylic acid has been studied by a spectrophotometric method in the ultraviolet. The molecular composition, extinction co-efficient and the dissociation constant of the complex have been determined at pH 3·0 and at wavelength 510 mμ. The molecular composition was determined by applying the method of continuous variation and showed the complex to be of the 1 :1 type. The extinction co-efficient of the complex at 310 mμ, and at pH 3·0 was found to be 3594 and that of Sulpho-salicylic acid to be 2036. The dissociation constants have been determined at ionic strengths 0·02 and 0·05; the values being $2{\cdot}37 \times 10^{-5}$ and $4{\cdot}32 \times 10^{-5}$ respectively.

66. Explanation of anomalies in stabilization of higher oxidation states of metals by complex formation.

C. S. SHARMA, Patna.

Octahedral Ni (II) and planar Cu (II) complexes are examples of serious anomalies, since in spite of promotion of electrons to higher electronic levels on the basis of their proposed configurations, they are not oxidizable.

The anomaly in case of Ni is explained by assigning sp^3d^2 bonding instead of the proposed d^2sp^3 bonding to its octahedral complexes. This would account for its octahedral structure, paramagnetism, resistance to oxidation and lower stability compared to octahedral complexes of Co (III) (having d^2sp^3 bonds). This is supported by the fact that, whereas the heat of formation of an octahedral complex of Co (II) is sufficient for promoting one electron from 3d to 5s level, the considerably larger amount of energy required for promoting two electrons from 3d to 5s level in the case of Ni (II) cannot be provided by the heat of formation of the complex, d^2sp^3 bonding is, therefore, inhibited.

Formation of planar complexes of Cu (II) requires promotion of an electron from 3d to 4p level. This involves little loss of energy (as shown by Pauling), hence, promotion in this case has little effect on resistance offered by Cu (II) to oxidation.

67. Action of Nitrogen Tetroxide and its thermal dissociation products on Sodium salts of Acetic, Benzoic, Succinic and Phthalic acids.

VASANTRAI TRAMBAKLAL OZA, Visnagar.

The action of nitrogen tetroxide and its thermal dissociation products on sodium benzoate, succinate, acetate and phthalate has been studied at a few temperatures below 100°C, with a view to understand this elegant method for preparing anhydrides of organic acids A method has been devised to determine accurately all the products of reaction The reaction is found to be temperature dependent and is therefore presumably the reactions of the salts with nitrogen di-oxide By conducting similar experiments with nitrogen tetroxide and the anhydrides of these acids, it was determined that the anhydrides did not react with the oxides of nitrogen.

Reactions of nitrogen tetroxide on sodium acetate succinate and phthalate have been already studied, but that of nitrogen tetroxide and its thermal dissociation products on sodium benzoate does not seem to have been investigated in the past This method of preparing anhydrides of organic acids is interesting because the sodium nitrate, a solid product of reaction, being an electrovalent compound is insoluble in solvents like benzene, carbon tetrachloride, etc , so that the separation of the anhydride from the admixed nitrate is easy

68. Studies on metallic halide dioxanates—Part II.

S G K NAIR and S S MOOSATH, Trivandrum

Dioxanates of cupric and ferric chlorides have been prepared by the new procedure developed by the authors The metallic hydroxide dried to constant weight at 160°C is suspended in dry dioxan and treated with hydrogen chloride gas The solution is filtered and the filtrate cooled The crystalline dioxanates thus obtained have been analysed and their composition established Stabilities and other properties of the dioxanates of cupric chloride and ferric chloride have been investigated

69. The System Barium Chloride—Urea—Water at 35°C.

S. K SIDDHANTA and K SWAMINATHAN, Kharagpur

The ternary system $BaCl_2-CO(NH_2)_2-H_2O$ has been investigated at 35°C by the synthetic complex method and the isotherm at 35°C has been drawn The system does not reveal any solid complex between $BaCl_2$ and urea and the only two pure solid phases are those of urea and $BaCl_2 2H_2O$ The branch of the isotherm with pure urea as solid phase shows a break suggesting the probable existence of two polymorphic modifications of urea The solubility of urea (for a fixed amount of water) is increased by $BaCl_2$ and vice versa.

70. The System of Barium Chloride—Thiourea—Water at 35°C.

S K SIDDHANTA and K. SWAMINATHAN, Kharagpur

The phase equilibrium in the ternary system $BaCl_2-CS(NH_2)_2-H_2O$ at 35°C has been studied by the synthetic complex method and the isotherm at 35°C has been drawn. The system does not reveal any solid complex between $BaCl_2$ and thiourea and the only two pure solid phases are those of thiourea and $BaCl_2 2H_2O$. The branch of the isotherm with pure thiourea as the solid phase shows a discontinuity indicating the probable existence of two polymorphic modifications of thiourea.

$BaCl_2$ brings about a decrease in the solubility of thiourea and this salting out data gives a value of 8 for the hydration number of barium ion when calculated from an equation, developed by us.

71. Potassium Monofluorothioxy Uranate (VI).

A. V. HARIHARAN and GRIHAPATI MITRA, Bombay.

Potassium Monofluoro trioxy uranate (VI) KUO_3F has been prepared by fusing equimolecular quantities of UO_3 and KF at a temperature of about 850°C. KUO_3F is faint yellow in colour and sparingly soluble in water. It can be heated to a high temperature without the fear of decomposition. This compound was found to decompose in presence of mineral acids. Organic acids such as oxalic, acetic etc., on the other hand dissolve this compound and crystalline salts e.g. KUO_3F, $2CH_3COOH$ etc. were obtained. KUO_3F, $2CH_3COOH$ when heated to a high temperature (400°C approximately) left KUO_3F.

72. Uranyl Monofluoro Phosphate.

M. S. SUBRAMANIAN and GRIHAPATI MITRA, Bombay.

Uranyl monofluorophosphate was prepared by adding equimolecular quantity of hydrofluoric acid to a weighed amount of uranium trioxide taken in a platinum basin followed by digesting the solution with the requisite amount of phosphoric acid. The digestion was carried for about 2 hours and the temperature was approximately 90°C. The solution was filtered, concentrated and allowed to crystallise under high vacuum. Uranyl monofluoro phosphate was obtained as a fainly yellow glassy mass. The compound has been found to be highly soluble in water and crystallises with four molecules of water.

73. Physico-chemical studies on the complex arsenates of metals--Part V.—Thermometric studies on the composition of bismuth arsenate complexes.

M. S. BHADRAVER, Bikaner.

The composition of so-called bismuth arsenate has been studied by the thermometric measurements involving the thermometric titrations between bismuth nitrate and disodium hydrogen arsenate in aqueous and alcoholic medium. The direct titration curves suggest the formation of Bi Aso_4 in which the ratio of Bi : As is 1 :1. In the reverse titrations also the formation of the same compound Bi Aso_4 is indicated. The composition of bismuth arsenate is Bi Aso_4.

74. Spectrophotometric Determination of Iron with Quinolinic Acid.

A. K. MAJUMDAR and S. P. BAG, Jadavpur.

Quinolinic acid has been used as a reagent for the spectrophotometric estimation of traces of ferrous iron. The complex shows the regions of maximum absorption to be at 440 mμ in presence of potassium cyanide. At this wave-length it adheres to Beer's law from 1 to 16 p.p.m. of iron, the optimum concentration range is between 4 and 16 p.p.m., where the % relative error per 1% absolute photometric error is 2·94.

The reagent is selective, sensitive and practically specific as it gives no colour with any other metal ion. The sensitivity of the colour reaction is 0·019 γ per cm^2

(Sandell) and small quantities of iron are estimated in presence of large number of cations with potassium cyanide as colour intensifying agent. In solution, the complex, with the instability constant of $2{\cdot}7 \times 10^{-5}$, contains the metal and the reagent in a ratio of 1 :1. The molar extinction coefficient of the complex is 2946.

75. Spectrophotometric determination of Iron with 2-Hydroxy-3-napthoic acid.

A. K. MAJUMDAR and C. P. SAVARIAR, Jadavpur.

2-Hydroxy-3-napthoic acid is presented as a new, highly sensitive and selective reagent for its colour reaction with ferric ion The sensitivity of the reaction is 0·025 γ per cm.^{2} (Sandell). The blue coloured complex gives maximum absorption at 590 mμ and obeys Beer's law up to 24 p.p.m. of iron. The optimum range of concentration is from 4 to 20 p.p.m. of iron, where the per cent relative analysis error per 1% absolute photometric error is 2·9. The composition of the complex, as evaluated by Job's method and as verified by the Molar and Slope ratio methods, shows that in solution the complex contains the iron and the reagent in a ratio of 1 :1. The empirical formula of the complex is suggested as $Fe[(C_{11}H_6O_3)]^{+3}$. The molar extinction coefficient is 2212 and the instability constant of the complex is about $4{\cdot}29 \times 10^{-4}$. Coloured ions or those ions that give coloured products are tolerated to a limited extent during the determination of iron.

76. Spectrophotometric determination of Copper and Osmium with Tiron.

A. K. MAJUMDAR and C. P. SAVARIAR, Jadavpur.

The reagent Tiron forms a soluble greenish yellow complex with copper. The sensitivity of the colour reaction is 0·24 γ of copper per cm^2. The colour system at a pH of 6·1 to 6·9 is stable for over 24 hours and shows a maximum absorption at 375 mμ. It obeys Beer's law at the latter wave length with the copper concentration of 10 to 160 p.p.m. The optimum range, however, is from 50 to 160 p.p.m. of copper, where the per cent relative analysis error per 1% absolute photometric error is 2·94. Job's method of continuous variation and the molar ratio method of Yoe et al indicate that in solution the complex contains the metal and the reagent in a ratio of 1 :2 with a dissociation constant of the order $5{\cdot}3 \times 10^{-6}$.

A method for the spectrophotometric determination of osmium with tiron as a reagent has been described. The reagent forms a soluble and stable coloured complex on heating with osmium in presence of sodium acetate. The regions of maximum and minimum absorptions are at 470 mμ and 410 mμ, respectively, and the system obeys Beer's law from 2 to 32 p.p.m. of osmium. But the optimum range, with the relative analysis error of 2·878% per 1% absolute photometric error is from 8 to 24 p.p.m. of osmium. The sensitivity of the reaction is 0·033 γ per cm^2 (Sandell) and the molar extinction coefficient is 5706.

In solution the complex is formed with the osmium and the reagent being in a ratio of 1 :1 and having the instability constant equal to $5{\cdot}57 \times 10^{-5}$ approximately.

77. Spectrophotometric determination of palladium. Part III. 2-mercaptobenzothiazole and 2-mercaptobenzimidazole as analytical reagents. A comparative study.

A. K. MAJUMDAR and M. M. CHAKRABARTTY, Jadavpur.

As spectrophotometric reagents for palladium, 2-mercaptobenzothiazole and and 2-mercaptobenzimidazole behave more or less in the same way. Colour systems formed by them, at a pH region of 3·0 to 6·5, obey Beer's law at 380 mμ with palladium concentration of 0·4 to 6·0 μg per ml. and the optimum range with the minimum error is from 1·6 to 4·0 μg of palladium per ml. at 30·1% and 35·8% transmittancies with 2-mercaptobenzothiazole and 2-mercaptobenzimidazole respectively. That in solution the complexes are formed with the metal to reagent ratio of 1 :2 and with the dissociation constants of the order of 10^{-12} has been ascertained by Job's method.

78. Composition of some less familiar metal Ferrocyanogen Complexes—Part I. Chromic Ferrocyanide.

S. IFTIKHAR ALI and WAHID U. MALIK, Aligarh.

On titrating chromic chloride against potassium ferrocyanide conductometrically at varying concentration of the reagents and at different temperatures, evidence for the formation of the following complexes from the curves could be obtained : (i) $KCrFe(CN)_6$ and $K_5CrFe(CN)_6$ 2 at 21° and 40°, (ii) $KCrFe(CN)_6.CrCl_3$ at 60°. At temperatures above 80°, curves exhibit a number of breaks indicating complexes with ratios, $K_4Fe(CN)_6$:$CrCl_3$ as 1 :1, 4 :1, 1 :2 and 3 :2; the whole bulk of the solution became highly viscous or gelatinous precipitates obtained, depending on the concentrations used. To have a relatively clearer insight into the latter, the precipitates obtained by mixing $K_4Fe(CN)_6$ and $CrCl_3$ at 80°, in different ratios where analysed. The formulae for the different complexes are (i) $KCrFe(CN)_6$ (ratio 1 :1, (ii) $K_5CrFe(CN)_6$ (ratio 2 :1), (iii) $Cr_4Fe(CN)_{6\,3}$ (ratio 3 :4).

Amperometric titrations, using Fischer electropode with external multiflex galvenometer, gave evidence to the fact that the composition of the complex varies with the concentration of $CrCl_3$. $Cr_4\,Fe(CN)_6$, is formed at concentrations below ·0017M, and $2KCrFe(CN)_6.K_4Fe(CN3_6$ at ·0033M and above.

These complexes show adsorptive and hydrolytic character. Evidence for this is available by conductometric results in aqueous and aqueous-alcoholic medium. Amperometry when carried out under these conditions do not throw any light on this particular nature of the complex.

79. Polarographic Studies on Copper (II)—tripolyphosphate complexes.

C. S. RAMANATHAN and R. S. SUBRAHMANYA, Bangalore.

The polarographic behaviour of copper in presence of tripolyphosphate as complexing agent has been studied employing different concentrations of tripolyphosphate. It is noticed that there are two waves. Both the waves correspond to the reduction of $Cu{+}{+} \longrightarrow Cu$. The different waves that are obtained are due to sluggish equilibrium between the different species of complexes. From the shift in the half-wave potential it has been concluded that two molecules of tripolyphosphate enter the complex, which gives the first wave. Due to the highly extended nature of the second wave it is not possible to draw any conclusions regarding the composition of the complex it represents. A.C. polarographic technique has given clear indication for the formation of at least two complexes.

80. Polarographic Studies on Cadmium—hexametaphosphate complexes.

C. S. RAMANATHAN and R. S. SUBRAHMANYA, Bangalore.

The polarographic behaviour of cadmium in presence of hexametaphosphate has been studied employing different concentrations of the complexing agent. The values of $E_{\frac{3}{4}}-E_{\frac{1}{4}}$ indicate that the reduction process is reversible in character. The shift in the half-wave potential for a ten-fold change in the concentration of the complexing agent indicates that two molecules of hexametaphosphate are associated with each metal ion. When carbonate or hydroxide is incorporated in the base solution in varying amounts, no shift in the half-wave potential is noticed indicating that $CO_3^{=}$ or OH^- does not enter the complex.

81. Polarographic Studies of copper-ethylene diamine complexes.

K. SRINIVASAN and R. S. SUBRAHMANYA, Bangalore.

The study of the polarographic behaviour of cupric copper in presence of both ethylene diamine and ammonia has been undertaken since it has been noticed that two waves are obtained with cupric copper in presence of ethanolamines and ammonia, while only one wave is obtained when ethanolamines alone are present. At the same time the effect of adding a sodium hydroxide and sodium carbonate to the base solution is also investigated with a view to finding whether any mixed complex is formed. The study reveals that in presence of low concentrations of ethylene diamine, one carbonate group or one hydroxyl group enters into the complex along with two molecules of ethylene diamine. In presence of ammonia and ammonium chloride, however, the electrode process becomes irreversible, the degree of irreversibility decreasing with increasing concentration of ethylene diamine keeping the concentration of ammonia at one molar. It is difficult to arrive at any conclusion at present regarding the reduction mechanism under these conditions of varying irreversibility.

82. Preparation and spectrophotometric studies on Peroxy Titanium Maleate.

G. V. JERE and C. C. PATEL, Bangalore.

Peroxy titanium maleate has been prepared for the first time by the reaction of excess maleic acid with freshly prepared titanium hydroxide suspended in excess of hydrogen peroxide in dark and at room temperature. The clear solution on evaporation by passing dry air yielded an orange red solid. The purified solid on analysis gave the molar ratio of Ti :C :H (excluding that of H_2O) :O(peroxy) : H_2O as 1 :4 :2 :0·84 :3. The complex contained a true peroxy group and an ethylenic linkage. Spectrophotometric investigations on the complex gave two absorption maxima—one at 354 mμ indicating the presence of $-HC=CH-$ chromophoric group and the other at 400 mμ due to the peroxy linkage in the complex. The complex obeyed Beer's law at 400 mμ in the range 4 to 38 p.p.m. of titanium in solution. The absorption maxima shifted towards longer wave-lengths with the increase in concentration of the complex. Addition of sulphuric acid to the complex solution gave the absorption maximum at 425 mμ showing the breakdown of the complex. The complex can be represented as $TiO_2(OOC.CH{=}CH.COO).3H_2O$.

PHYSICAL CHEMISTRY

83. Thorium and Ferric Tungstate Gels—Variations in Conductivity, Viscosity and H^+ Ion Concentration during Gelation.

S. ANWAR ALI and WAHID U. MALIK, Aligarh.

Thorium and Ferric Tungstate gels were obtained by adding dropwise (with vigorous shaking) dilute solution of sodium tungstate (0·1 M) to thorium nitrate (0·5 M and 0·75 M) and Ferric chloride (1·0 M and 1·3 M). The mixture was subjected to dialysis. It was observed that (i) higher the concentration of electrolyte used, the larger was the time of setting, (ii) the time of setting was found to decrease with the increase in the period of dialysis, (iii) dilute solutions of KCl and $BaCl_2$ bring about coagulation even after sufficient dialysis (10 and 230 hours respectively) but when dialysis is carried out to a stage when the gel can be obtained without the addition of foreign electrolyte, addition of KCl and $BaCl_2$ bring about instantaneous gelation, (iv) gels on treatment with excess of Th^{4+} and Fe^{3+} change into sols.

Conductivity variations were quite large in the early stages but very small near the gelation stage—a behaviour resembling to some extent with prussian and turnbull blues (J. Phys. Chem. 59, 488 (1955). On the contrary, variations in viscosity were small in the beginning but a marked increase was observed near the stage where the mixture shows tendency for setting to a gel. pH variations were irregular and apparently no support to the results on conductivity and viscosity variations could be obtained on the basis of these measurements. Results are discussed.

84. Oxidation of Manganous ions by Acid Dichromate.

B. P. GYANI and S. N. PRASAD, Patna.

Potentiometric titrations of manganous sulphate by $K_2Cr_2O_7$ in different concentrations of sulphuric acid (N to 8N) show that the net oxidation is $2MnSO_4 + H_2SO_4 = Mn_2(SO_4)_3 + H_2O$. None of the oxygen available from $K_2Cr_2O_7$ is wasted in side reactions since substantially the same result is obtained when the titration is reversed. A slight excess of manganous sulphate is required in the reverse titration perhaps due to delayed equilibrium.

85. Novel type of electrolysis—alternating current electrolysis using semicoductor electrodes.

DR. H. V. K. UDUPA, Karaikudi.

The use of electrolytically deposited lead dioxide on graphite, electrolytically formed aluminium oxide on aluminium and tantalum oxide on tantalum as one of the electrodes in a.c. elctrolysis using acid electrolyte was found to lead to rectification of a.c. and oxidation reaction could be brought about at the other electrode such as platinum. Preliminary results obtained in the oxidation of manganous sulphate to manganic sulphate and cerous sulphate to ceric sulphate are reported.

86. Viscometric and Conductometric studies on arsenious sulphide, hydrous ferric oxide, gold and selenium sols. in the presence of non electrolytes.

A. C. CHATTERJI and PARAMHANS TEWARI, Lucknow.

Changes of viscosity of sols due to the addition of non-electrolytes to them have been followed by viscometric measurements. It is observed that in the presence of all those non-electrolytes which increase the viscosity of the medium and also show a corresponding increase in the viscosity of the sol (even though the relative viscosity of the latter may not increase) stabilisation results. The increased viscosity of the medium might slow down the coagulation rate of the sol as required by Smoluchowski's equation. But when there is a decrease in the relative viscosity of the sol in the presence of the non-electrolytes, sensitisation takes place and that might possibly be due to dehydration of the sol particles.

Changes of electrical conductivity during coagulation of arsenious sulphide sols have been observed with and without the addition of non-electrolytes to them for studying the effect of the latter on the extent of the dissociation of the coagulating electrolyte and also on the coagulation-process of the sols. It has been observed that a non-electrolyte which decreases the conductivity of the ultrafiltrate of the sol+ the coagulating electrolyte or rather decreases the dissociation of the electrolyte should normally stabilise the sol. In those cases where the conductivity of the sol+electrolyte in presence of the non-electrolyte is less than that of the sol electrolyte alone, the sol is stabilised. If, on the other hand, the conductivity of the sol+electrolyte in presence of the non-electrolyte is more than that of the sol electrolyte alone, the sol is stabilised. If, on the other hand, the conductivity of the sol+electrolyte in presence of the non-electrolyte is more than that of the sol electrolyte alone, the sol may be sensitised.

87. Studies in inorganic polyelectrolytes—Part II. Graham's Salt : Viscocity Behaviour of Aqueous Solutions and Effect of Addition of Electrolytes.

A. C. CHATTERJI and HARIHAR NATH BHARGAVA, Lucknow.

Viscosity behaviour of many samples of Graham's salt of varying molecular weight has been observed. Reduced viscosity ($\eta sp/c$) versus concentration curves were found to be characteristic of poly-electrolytes. They were molecular weight dependent, and could be reduced to straight lines by plotting reciprocal of reduced viscosity against square root of concentration. The intrinsic viscosities obtained by extrapolation were found to be proportional to the square of molecular weights. The value of reduced viscosity at any particular concentration in the concentration range between 0·25% and 4·0% was found to be linearly related to the molecular weight.

Reduced viscosities were found to decrease considerably on addition of electrolytes. Reduced viscosity versus added electrolyte concentration curves were remarkably molecular weight dependent. pH of the medium seemed to have no effect at all. Bivalent salts reduced the viscosity to a much greater extent than monovalent ones. By keeping the concentration of the added salt constant and varying that of Graham's salt, curves showing humps which disappeared at higher concentration of the added salt were obtained.

Most observations merely confirm the already well-established folding-chain theory of polyelectrolytes developed by Fuoss, Katschalsky and others.

88. Kinetics and Mechanism of Oxidation of n-Propyl Alcohol and Capryl Alcohol by Chromic Acid.

A. C. CHATTERJI and VARKEY ANTONY, Lucknow.

A kinetic study for the oxidation of n-propyl alcohol and capryl alcohol with chromic acid in perchloric acid solutions has been made. The order of the reactions with respect to alcohols, chromic acid, and hydrogen ions have been found to be one, one, and two, at higher concentrations of hydrogen ions and one, one, and one, at lower concentrations of hydrogen ions. The temperature coefficients for the various temperature ranges between 25° and 55°C at various concentrations have been determined. In presence of perchloric acid the effect of light is negligible. The effects of some inorganic salts on the oxidation rates have been studied. An attempt has been made to generalise the ester mechanism for the oxidation of monohydric alcohols by chromic acid.

89. Effect of Structure on the Rates of Oxidation of Monohydric Alcohols and Aliphatic Aldehydes by Chromic Acid.

A. C. CHATTERJI and VARKEY ANTONY, Lucknow.

A general study of the temperature coefficients of the oxidations of n-propyl alcohol, iso-propyl alcohol, n-butyl alcohol, sec-butyl alcohol, iso-butyl alcohol, and sec-hexyl alcohol and acetaldehyde, n-butyraldehyde and iso-butyraldehyde by chromic acid in presence of perchloric acid allowed the calculation of relative thermodynamic quantities (energies, entropies and free energies of activation) relative to those of iso-propyl alcohol.

The reaction rates increase with the increase of the molecular weight. The methyl group has a general effect of decreasing the energy of activation. The entropy of activation values indicate that the rigidity of the compounds is probably in the order: iso-propyl- > sec-butyl- > sec-hexyl- > n-butyl- > iso-butyl- > n-propyl-alcohol; iso-butyraldehyde > acetaldehyde > n-butyraldehyde. The free energies of activation show a very good parallelism with the rates of oxidation.

90. Temperature Coefficients of the Rate of Oxidation of Ethylene and Methylated Ethylene Glycols by Chromic Acid.

A. C. CHATTERJI and SAMIR KUMAR MUKHERJEE, Lucknow.

A general study of the temperature coefficient of the oxidation of ethylene glycol, propylene glycol, 2:3 butylene glycol, and pinacol by chromic acid in presence of perchloric acid at constant ionic strength, with special reference to the effect of temperature and concentration of the reactants on the temperature coefficient, has been made. The reaction rates have been measured between the temperature range from 25° to 55°C. The general effect of methyl substitution is to increase the reactivity. From a determination of the temperature coefficients, the relative thermodynamic quantities (energies, entropies and free energies of activation) with respect to those of ethylene glycol have been calculated. An attempt has been made to establish a correlation between the structure of glycols and their oxidation rates with chromic acid.

91. Temperature Coefficient of Catalyzed Reactions.

A. C. CHATTERJI and SAMIR KUMAR MUKHERJEE, Lucknow.

In continuation of the studies reported in the preceding paper, we have now investigated the temperature coefficients of chromic acid (in perchloric acid) oxidations of formaldehyde, ethylene glycol, propylene glycol, 2:3 butylene glycol and pinacol in presence of manganous and cerous salts, which act as negative catalysts, at various concentrations. From the values of temperature coefficients, the energy of activation, the frequency factor, the entropy of activation and the free energy of activation have been calculated in each case. The results agree fairly well with Dhar-von Halban rule. Suitable explanations have been given for the changes detected in the above activation quantities.

92. Effect of salts on optical rotation and electronic spectra.

S. K. K. JATKAR and A. J. MUKHEDKAR, Poona.

Rotatory dispersions of d-tartaric acid in different salt solutions were determined by using a photoelectric polarimeter. Absorption spectra of d-tartaric acid and r-mandelic acid in different salt solutions were determined in the wavelength range of 204-240 mμ and 213-270 mμ respectively.

The changes in optical rotation with the nature and concentration of salt explained as due to coordination of cations which would in turn affect the internal rotation and the vicinal effect; it is confirmed by the shift in absorption maxima with the addition of salt to aqueous tartaric acid solution.

93. Study of the Sucrose Alkali Complex.

A. J. DANGRE and S. K. K. JATKAR, Poona.

The complex formation between sucrose and hydroxides of alkali and alkaline earth has been studied by the potentiometric method. The degree of complex formation is highest in the case of calcium hydroxide and decrease of the order of Ca^{++}, K^{+}, Na^{+}, Ba^{++}, Sr^{++}.

94. Dielectric Constant and Dipole Moment: Camphor.

S. K. K. JATKAR and C. M. DESHPANDE, Poona.

The dielectric constant and density of concentrated solutions of camphor in benzene have been measured over a range of temperature. The literature data for the dielectric constant of liquid and solid camphor is recalculated by applying the new equation. The new moment in liquid state and in solution indicates an increased freedom of rotation whereby $2j+1=2$ (1kT) increases to $2j+1=3$ (1·5kT). The moments thus increased compare well with the moment in the solid state and also with the theoretical value for the moment of the molecule.

95. Ultrasonic Velocity in Liquid Binary mixture.

S. K. K. JATKAR and M. V. KAULGUD, Poona.

The velocity concentration curves for a number of binary mixtures have been studied. It is found that the velocity curves in general show a negative deviation from addivity except in cases where a complex is formed. In terms of the free volume model of the liquid state, the negative deviations are due to an increase in the free volume. Systems characterized by an almost total absence of interaction between the components (e.g. ethylene dichloride in heptane) show minima in the velocity-concentration curve. The adiabatic compressibility-concentration curves however show both +ve and −ve deviations. This anomaly can be explained by making use of the excess compressibility β^{E} (Prigogine) which is a function of the excess volume V^{E} and $\frac{\delta V}{\delta p}$.

96. Magnetic Susceptibilities of Binary Mixtures.

S. K. K. JATKAR and V. S. JATKAR, Poona.

In the present paper the authors have studied the magnetic susceptibility of the following binary mixtures :

(1) Anisole with chloroform and carbon tetrachloride.

(2) Benzene with trichlorethylene, chloroform, carbon tetrachloride, ethylene dichloride and pentachlorethane.

The results have been compared with the previous data on the system chloroform ketones.

In all the systems it was found that there was marked deviations from the law of additivity not only at 1 :1 ratio, but also at 1 :2 and 2 :1.

The results have been explained on the basis of hydrogen bond formation.

97. Potentiometric studies of strong electrolytes.

S. K. K. JATKAR and MISS VIJAYA JOGAL, Poona.

Study of the complex formation and double salt formation in solutions of beryllium nitrate and ammonium nitrate by precision potentiometric technique has given strong inflections at stoichiometric ratios, $Be^{++} : NH_4^+$ as, m : n where m varies from 216, 125, 64, 54, 36, 27, 24, 21, 20, 19, 18, 16, 14, 13, 12, 11, 10, 9, 8, 7 in forward system and n varying from 125, 100, 64, 60, 54, 48, 36, 30, 27, 25, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8 etc.

Similar results are obtained with the mixture of NaCl and KCl.

These results would indicate the formation of a super lattice structure of ions in solution.

98. Volume changes during the mutual coagulation of sols.

K. KRISHNAMURTI and N. V. KARBELKAR, Nagpur.

The process of mutual coagulation of highly dialysed sols. is accompanied by a small but measurable volume change e.g. the mutual coagulation of ferric oxide sol. and a negative sol. the volume increase per 100 c.c. of completely coagulating sol. mixture was smallest with mastic sol. being 0 00078 c.c. It was 0·000104 c.c. with arsenic sulphate sol., 0·0011 c.c. with congo red sol. and the highest increase was 0 00123 c.c. with prussian blue sol. However, there is a decrease in volume with gelating mixtures of ferric oxide and vanadium pentoxide sols. When alumina sol. is coagulated by congo red, prussian blue or arsenious sulphide sols. similar small increase in volume is observed. The volume increase is of the order of 0·0000095 c.c. per c.c. of ferric oxide sol., 0·000017 c.c. per c.c. of congo red sol., 0·0000059 c.c./c.c. of arsenic sulphide sol. The volume changes during electrolytic coagulation are still smaller in magnitude. The volume increase is obviously due to the release of more strongly bound solvation water consequent on loosening of water dipoles of solvation accompanying the lowering of electrokinetic potential and the decrease in the free surface during the process of mutual coagulation.

99. Conductivity behaviour of coagulating sol. mixtures.

K. KRISHNAMURTI and N. V. KARBELKAR, Nagpur.

An immediate fall in specific conductivity is observed on mixing the oppositely charged sols., and the decrease is observed with coagulating as well as non-coagulating mixtures, indicating an immediate formation of primary aggregate interaction of stabilizing ions (of ferric ion from ferric oxide sol. with the ferrocyanide ion from prussian blue, the anion from congo red sol., or vanadium pentoxide sol.).. The extent of conductivity fall is generally proportional to the rate and extent of mutual coagulation. Because of electrolytic character of the congo red sol. the fall in conductivity in mutual coagulation with congo red sol. is greater. When there is no specific interaction between the stabilizing ions of the two sols. (Ferric oxide and neg Ag I) the fall in conductivity is smaller, here exchange adsorption lowers the electrokinetic potential, and hence the stability of sol. mixture. The ultramicroscopic examination supports the mechanism of mutual coagulation arrived from these observations

100. Composition of Coagula formed in the Mutual Coagulation of Sols.

N V KARBELKAR and S V SOMAN, Nagpur

The composition of coagula obtained in the mutual coagulation of arsenic sulphide and ferric oxide sols has been investigated by colorimetric method employing molybdenum blue and sulpho cyanide reactions The sols on mixing always form the primary aggregates instantaneously These may show secondary aggregation only if primary aggregates have low electrokinetic potential The aggregates are always of composite nature Ordinarily the sol in excess in the reacting mixture is also in excess in the coagula Two types of primary aggregates may be formed (a) the stable aggregates with too much of one sol and (b) the less stable aggregates with not too much disparity in the relative amounts of the sols With increased concentration of the sols the disparity in the composition of the coagula and that of supernatent sol mixture in contact decreases At lower temperatures relatively larger amounts of ferric oxide are present in the coagula The finer particles of one sol appear to link together and aggregate around the bigger particles of the second sol Both the physical mutual adsorption of the particles of the two sols, (b) as well as, chemisorption, ion-exchange or precipitation factors appear to be responsible for the process of mutual coagulation R. J. Goldberg's statistical theory of mutual precipitation of antibody and antigen appears to apply to the process of mutual coagulation of hydrophobic sol as a first approximation

101. Viscosity changes during the mutual coagulation of sols.

N. V. KARBELKAR, Nagpur.

The variation in the viscosity of coagulating mixtures of oppositely charged sols. viz. ferric oxide and prussian blue, has been followed by us with Ostwald's viscometer at a constant temperature. The viscosity of the mixture is always higher than its calculated volume even at the instant the two sols. are mixed and shows a further steep rise reaching a maximum value followed by a more gradual fall. The height of the maximum increases with increasing concentrations of coagulating sols. A rise of temperature brings about a rapid attainment of maximum although the magnitude of the maximum is decreased. The initial rise is due to aggregation, enmeshing of water and rise of structural viscosity through the formation of branched ramified aggregates while the fall in viscosity is due to fall in the number of dispersed units, growing compactness of aggregates and their desolvation and decreased electrovisous contribution on lowering of the electrokinetic potential.

102. The electrometric behaviour of mixtures of mutually coagulating-sols.

N. V. KARBELKAR, Nagpur.

The electrophoretic mobilities of the aggregates in the mixtures of mutually coagulating sols. have been studied by the moving boundary method. There is an instantaneous formation of primary aggregates indicated by the sudden initial fall of the electrokinetic potential on mixing the sols. With progressive addition of a negative sol. to a positive one the electrokinetic potential first decreases, passes through Zero, takes the opposite sign and then increases and while its magnitude is small further secondary aggregation leading to mutual coagulation occurs. The formation of primary aggregates always occurs and secondary aggregation occurs only if the resultant electrokinetic potential of the primary aggregates is small. Exchange adsorption or precipitation interaction of stabilizing ions and mutual adsorption of the particles of the two sols. brings about the lowering of the electrokinetic potential. Many coagulating sol. mixtures showed this behaviour.

103. Electrolysis of KCNS Solutions.

B. P. GYANI and MISS R. MISRA, Patna.

Potassium thiocyanate solutions have been subjected to electrolysis at different concentrations and acidities. The primary reactions at the electrodes appear to be analogous to those in Kolbe's synthesis of hydrocarbons. It appears that the alkali liberated at the cathode may be consumed in secondary reactions in the cell. Perhaps dithiocyanogen is the first product at the anode, but only when the concentration of KCNS is more than 2%. At high concentrations of KCNS (near saturation) a red solution is obtained first which changes rapidly to a yellow ppt. In weaker solutions (2-5% and perhaps more) only a yellow ppt is formed in neutral or acid solutions, and a white one in alkaline solutions. There is no sulphur in these precipitates. Perhaps they are polymers of dithiocyanogen.

104. Electrolysis of mixtures of Ferric Chloride and Potassium Thiocyanate.

B. P. GYANI and MISS R. MISRA, Patna.

A black deposit of iron is obtained at the cathode when these mixtures are electrolysed either in presence of excess thiocyanate or when acid is present. There is no deposit when Fe+++ and thiocyanate are in equivalent quantities or Fe+++ is in excess (neutral solutions). It appears that a reducing agent (Nascent hydrogen or excess thiocyanate) must be present for deposition.

In neutral solutions the red colour discharges rapidly at the cathode and slowly at the anode and after prolonged electrolysis a red band appears in the middle nearer the cathode. This phenomenon is independent of the ratio of the two salts in the mixture, total concentration, presence of acid, and shape of the vessel. The red band is fairly stable but on stopping the current tends to diffuse away slowly. On reversing the current a white turbidity is produced at the site. The red band reappears if the current is reversed again. It is tentatively suggested that a number of unknown substances are formed during electrolysis aud a material gradient is set up from one electrode to another. The red band may be at the site where a number of specific substances reach specific concentrations.

105. The bright Platinum Electrode.

B. P. GYANI and RAM KISHORE PRASAD, Patna.

It has been shown that many titrations of different types e.g. those in which there is a precipitate or a complex compound is formed; those in which an oxidizing agent is removed, not necessarily by reduction; and those which depend upon changes in pH, may be conveniently and successfully carried out with the help of a bright platinum electrode as the indicator. Very satisfactory titration graphs of mineral acids with NaOH and aniline and phenol with bromine have been obtained. Ferric chloride may be titrated with complexing agents like sodium acetate or sodium fluoride. It is possible to analyse many mixtures (e.g. two salts, one salt and an acid) since two clear inflexions are obtained. It is possible to measure the pH of a solution with such an electrode after calibration with a known buffer but the range is limited to 3-9. It is not quite clear whether the electrode in these last measurements functions as a hydrogen electrode of indefinite hydrogen pressure or as an oxygen electrode.

106. Decomposition of Hydrogen Peroxide by hydrated Ceric Oxide.

B. P. GYANI and D. R. NABE, Patna.

The decomposition of hydrogen peroxide in presence of hydrated ceric oxide as observed from the oxygen evolved is of the first order when the concentration of the peroxide is not low and the ratio peroxide to ceric oxide is well above 0·5. At lower concentrations of H_2O_2, the reactions tend towards second order. The apparent energy of activation is 12000 to 12500 cal/mole. These observations have been explained on the basis that a complex between ceric oxide and hydrogen peroxide is formed, a steady state is attained and the complex breaks up into oxygen, the original catalyst and water after collision with a free H_2O_2 molecule from the solution. On heating the hydrated ceric oxide at increasing temperatures, it loses its capacity to form the complex and hence the power to catalyse decomposition. The activity is completely lost after heating for a few hours at 730°C, although the X-ray diagrams do not show any change in the structure of the oxide.

107. Conductometric estimation of Aluminium.

B. P. GYANI and B. R. GUHA, Patna.

A direct titration of Al+++ by NaOH gives low values for aluminium since some Al+++ are lost by adsorption on the precipitated $Al(OH)_3$. The error is decreased to 3 to 9% from 15-25% when comparable concentrations of Zn++ or Cd++ are present. The error becomes negligible when $Ba(OH)_2$ is used instead of NaOH or Na_2CO_3, no other external ion being necessary. Sodium hydrogen phosphate fails to give an inflexion.

108. Studies on Hexachloroceric Acid.

S. S. MOOSATH and M. R. A. RAO, Bangalore.

Stability, spectral characteristics and electrical conductivity of hexachloroceric acid have been investigated employing methyl alcohol as the solvent. At low temperatures, the compound is quite stable but when the temperature is increased above 40°C, the compound rapidly decomposes yielding chlorine and cerous chloride. The decomposition of the compound is also greatly increased by exposure to light. Studies on vapour pressure measurements at different temperatures reveal that the heat dissociation is 10·9 Kcals/mole. The absorption maximum occurs at 370μ and 310μ in dioxan and methyl alcohol solutions of the hexachloroceric acid respectively. The acid does not conduct electricity in dioxan solutions but when methyl alcohol is used as the solvent, the solution exhibits low electrical conductivity.

109. A new method of preparation of Uranium (IV) Oxyformate.

B. SAHOO and D. PATNAIK, Cuttack.

A very simple method of quantitative preparation of Uranium (IV) oxyformate at a low cost and in the pure state has been described. When a solution of uranyl formate with formic acid is exposed to bright sunlight for twelve to fifteen hours, complete reduction of uranium (VI) to uranium (IV) occurs. When the resulting deep green solution is distilled at a low pressure and at a temperature between 65°-70°C excess of formic acid and water is removed, leaving behind a pasty mass, which when dried over fused calciumchloride and solid sodium hydroxide in a vacuum desiccator overnight gives a pale green powder of uranium (IV) oxyformate having the formula $UO(HCOO)_2$, $1.5H_2O$. The preparation of this compound has assumed importance on account of its reaction with hydrofluoric acid at ordinary temperature resulting in the formation of uranium tetrafluoride which has been achieved in this laboratory by the authors.

110. The Preparation of Vanadyl Formate.

P. B. DAS and D. PATNAIK, Patna.

The separation of Uranium and Thorium has been worked out in this laboratory by the use of their formates. The separation of Vanadium from Uranium and Thorium is necessary as they occur together in nature. For the separation, the study of Vanadyl Formate has been undertaken. It was prepared by the action of Formic acid on Vanadyl hydroxides. The analysis of the compound showed that the formate with 1·3 molecules of water was obtained. The aquo-vanadyl formate when heated in vacuum at 100-105°C for 4-5 hours, the compound containing one molecule of water was obtained. This compound on further heating to 150-160°C in vacuum remained unchanged, showing that this one molecule of water is not loosely bonded or does not exist as the water of crystallisation. This presence of one molecule of water has also been verified from carbon and hydrogen estimation. This compound has been found to form complexes with thorium formate.

111. Wavelength standards from a pair of any differently coloured transparent materials.

N. V. PARTHASARATHY and INDRA SANGHI, Karaikudi.

The authors' new and simple technique, for calibrating the wavelength scale of spectrophotometers using isobestic point of indicators and null principle has been extended in the present paper. For example, five ordinary plain differently coloured glass strips have been taken and their transmission curves studied on a standard spectrophotometer. Then, any pair of suitably chosen coloured glass strips are found to have the same transmission at one or two well defined and known wavelengths. These particular points, where their transmission curves intersect can then be used as a reference for standardising optical instruments of uncertain wavelength scales. The method is very simple and easy and consists of merely sliding the two strips, one by one, in the path of the light beam and noting the difference in their transmissions, till at a particular wavelength, corresponding to the characteristic intersection point, they give the same transmission.

This method is cheaper, easier and more precise than other known methods.

112. Influence of surface active agents on Spectrophotometric determination of pH.

INDRA SANGHI and N. V. PARTHASARATHY, Karaikudi.

A detailed study of the influence of some surface active agents such as Manoxo 10T, Teepol, Dodecyl benzene sodium sulfonate (from Stanvac detergent 40E) on thymol blue has been made in acid solutions, employing the spectrophotometric technique of pH determinations. It was found that in all the above cases, good apparent shift of pH is obtained. However as the pk value for thymol blue is 1·7, absorbancy of acid standard at a pH of pk-2 cannot obviously be experimentally determined. Theoretical corrections for this have, therefore, been worked out, calculated and taken into account.

In all the above cases the pH determined spectrophotometrically was found to be less than the Sorenson value and this shift generally increased with increasing amounts of the wetting agent. However, when an attempt is made to give a quantitative interpretation on the lines suggested by Krishnappa et al it is found that our observed results do not fit in with the equation proposed by them. Krishnappa et al themselves found this to be the case with Nekal BX. It, therefore, appears from our studies that the case of the wetting agents investigated above corresponds more to that of Nekal BX than to the case of Igepon T and that a more comprehensive study taking into account some additional factors, the most important being the micelle formation, must be carried out before a general quantitative relationship can be correctly postulated.

113. Studies on the velocity of flow of solvents through chromatographic columns —Part IV. Effect of the gradation of the size of the particles on the values of the constant, $\frac{vh}{t} \times \frac{\eta}{d}$ derived from the rate flow of liquids through the adsorbent columns.

D. R. GUPTA and ABANI K. BHATTACHARYA, Naini Tal and Agra.

In previous communications the authors have reported their observations on the velocity of flow of pure organic liquids through different adsorbent columns packed in the same chromatographic tube.

Since the pores of the column are undoubtedly governed by the size of the particles, it was considered interesting to study the effect of a more restricted grading of particles on the flow of liquids. It is interesting to observe that $\frac{vh}{t}$ increases slightly as the grading of the particles becomes finer with corresponding increase in the value of $\frac{vh}{t} \times \frac{\eta}{d}$ or liquids of the same family and this has been shown by packing the columns with particles which were sieved and graded between 60-80 mesh, 80-100 mesh and 100-120 mesh. This slight increase in the velocity of flow, which adjusts itself with the values of η and d to give a constant value for the same family of compounds, has been explained by the shrinkage $\frac{vh}{t} \times \frac{\eta}{d}$, and swelling of the adsorbent particles by different liquids, the structural characteristics of the adsorbents and the liquids which undoubtedly influence the diameters of the capillaries of the adsorbents through which the liquids flow.

114. Structure of evaporated Cobalt Sulphide.

P. S. AGGARWAL and A. GOSWAMI, Poona.

The composition of precipitated cobalt sulphide is known to vary with the conditions of precipitation. In the present investigation the structures of cobalt sulphide formed by precipitation from sulphate solution in the presence of excess of ammonium acetate and also those evaporated in vacuo were studied. X-ray and electron diffraction show that the precipitated sulphide and the evaporated layers formed at about 220°C consisted mainly of CO_3S_4 having a spinel, structure at about 450°C a different cubic structure ($a_0 = 9{\cdot}907A^{\circ}$) consistent with Co_3S_4 composition was observed. This change appears to be due to decomposition of the spinel form of the cobalt sulphide facilitated by high temperatures and low pressures.

115. Behaviour of Anionic impurities in Alkali Halides.

A. K. DAS GUPTA and D. N. S. RAO, Poona.

Cationic impurities, when incorporated in crystals consisting of smaller sized cations, tend to migrate to the surface and eventually evaporate at fairly low temperatures. This new phenomenon can be explained in terms of overlap forces, Jhonson's hypothesis of preferential diffusion of impurities and the concepts of quantum rate theory, factors which should also hold for anionic impurities. Experiments, with the iodide ion as an impurity in KCl, have shown the evaporation phenomenon to be a property of both cations and anions.

From an accurate determination of evaporation rates, the optimum concentration for maximum evaporation, the diffusion coefficients for the anion and the activation energy for the process at different concentrations have been determined.

116. Critical study of standard electrode potential (E) in (i) Permanganate-Sulphuric acid and in (ii) Permanganate-Hydrochloric acid systems.

TARA CHANDRA GUPTA and ABANI K. BHATTACHARYA, Agra.

The values of E_0 were calculated in the above systems by varying the concentration of the acids and time. It was observed that there was some manganese dioxide also precipitated in these systems depending upon the time interval. The values of E_0 support the permanganate-manganous and not permanganate-manganese dioxide equilibrium. The E_0 values in the permanganate-hydrochloric acid system varies with the concentration of the acid and the time interval. Hence the suitability or unsuitability of these systems in the titration of ferrous salt by adding manganous sulphate and phosphoric acid has been discussed in the aspect of E_0 values.

117. Chemical Dosimetry using Mercuric Chloride. Part I—Hydrazine Sulphate as a Catalyst.

P. S. RAO, Poona.

The efficiency of hydrazine sulphate in the reduction of mercuric chloride under ultraviolet radiations has been compared with that of oxalates. The concentrations of sodium oxalate, potassium oxalate, ammonium oxalate, hydrazine sulphate and the time of exposure were varied, keeping the strength of $HgCl_2$ constant. The degree of reduction was estimated by the Jamieson's procedure. The reduction is found to be larger in the presence of increasing amounts of $N_2H_4.H_2SO_4$ (81 to 102 mg/l at 0·11 and 0·21 M respectively). However, the yields obtained are very small when compared to those in the presence of oxalates. The results can be explained on the basis of redox potentials and the reaction between $HgCl_2$ and $N_2H_4.H_2SO_4$ forming condensation products as is evidenced by the results of Rimini *et al.*

118. Dependence of the viscosity of the solutions of long chain Macromolecules on shearing stress.

C. I. JOSE, H. L. BHATNAGAR and A. B. BISWAS, Poona.

Studies on fractions of branched chain polymethyl methacrylate varying in molecular weight from 8,00,000 to 40,00,000 have been made in chloroform, ethylene dichloride, trichloro-ethylene, tetrachloroethane and acetone at several shearing stresses at 25°C.

The data are examined in the light of the various theories correlating the viscosities of macro-molecular solutions and shearing stress. Peterlin and Copic using hydrodynamic theory, and Bhatnagar, Biswas and Gharpurey on the basis of rate process theory have predicted that $[\eta]_f = [\eta]_{f^2 \to 0} - Bf^2$ where $[\eta]$ is intrinsic viscosity and B a constant. The present results have been used to evaluate the coefficient B in the above equation and its predicted dependence on the number of segments Z in a macromolecule using the light scattering data.

It is further observed that the values of $[\eta]_{f \to 0}$ are approximately 10 % higher than $[\eta]_{f^2 \to 0}$ for high molecular weight fractions.

119. Corrosion of Nickel coated mild steel.

B. C. BANERJEE, Poona.

A dissolution rate study of iron from mild steel discs coated with electro-deposited nickel having { 100 }, { 1010 } ÷ {211 }, { 110 } and {210 } orientations has revealed that, in hydrochloric acid solution, coatings with {210 } orientation gave the best protection to the iron. On the other hand, in neutral sodium chloride solution appreciable difference in the dissolution rate has not been observed. These results have been discussed with reference to electrochemical anisotropy of different faces of a single crystal and also to the texture of the deposits involving such considerations as the crystallite size, grain boundaries, orientations and mutual arrangement of the intercrystallite discontinuities.

120. Depolarisation Kinetic Study of Hydrogen in an inert gas atmosphere.

H. P. AGARWAL and R. S. VAIDYA, Bhopal.

The evolution of hydrogen from a cathodically polarised electrode in an inert gas atmosphere, is obeyed by Langmuir's adsorption Equation, as is corroborated from the linear relationship obtained between logarithms of depolarisation potential and the time taken for depolarisation of hydrogen.

121. Decomposition of Organic Halogen compound by Ultrasonic Waves—III. Sonochemical decomposition of Chloroform.

SATISH CHANDRA SRIVASTAVA, Calcutta.

Decomposition of aqueous solution of chloroform by ultrasonic waves (225 watts electrical input to the transducer, 2100 C/S and 990 KC/S frequency) has been studied in dark and a suitable mechanism has been proposed. A solid product is obtained during the decomposition. Effect of bulk, concentration and temperature has also been studied.

122. The aqueous polymerisation of Acrylonitrile.

MUKUL BISWAS, Calcutta.

Experiments on acrylonitrile polymerisation in aqueous system under nitrogen with the red-ox initiator hyposulphite-persulphate show that at a fixed hyposulphite concentration (0·01%), an increase of persulphate concentration from 0·05% to 0 2% raises initially the yield time curve i.e. the rate curve, but from a certain concentration on-wards rate curve is found to fall steadily with increase of $K_2S_2O_8$ concentration.

The cause of this anomaly has been traced to the fact that higher concentrations of the persulphate produces the polyacrylonitrile in a more coagulated condition instead of the fine sol obtained at low concentrations. The above view has been verified by measuring the liminal coagulation values of the sols obtained at various concentrations of the persulphate prior to the concentration at which the sol is precipitated. It has been found that the fall in the rate curve is attended by a fall in the coagulation values i.e. for e.g. from 10 millimoles/lit (0·06%) to 6·6 millimoles/lit. (·1%). The above view has also been verified by using a stabilizer such as a cationic soap which will protect the colloid, and stabilise it, and accordingly will increase the rate. On the contrary by using a foreign electrolyte as coagulant the rate is also found to decrease even though the initiator concentration is such that the rate should be very high.

It is concluded that the rate of heterogeneous polymerisation depends strongly on the physical nature of the separating phase, and higher is the rate the more finely-suspended is the polymer phase.

123. Kinetic study of the oxidation of P Xylene by Manganic Sulphate.

M. S. VENKATACHALAPATHY, R. RAMASWAMI and H. V. K. UDUPA, Karaikudi.

A kinetic investigation of the oxidation of p-xylene by manganic sulphate is described. Under the conditions employed, one of the methyl groups is attacked chiefly yielding p-tolualdehyde. Disruption of the aromatic nucleus does not take place. Resinous substances and self condensation products of certain intermediates are formed. The reaction is of the first order with respect to manganic sulphate. The manganic sulphate empoyed in these investigations was prepared electrolytically using lead electrodes and manganous sulphate in 55% sulphuric acid as electrolyte.

124. Generation of free radicals by Electrolysis and its application in polymerization.

V. L. N. MURTY, Calcutta.

The electrolysis of Potassium Laurate and Sodium Acetate has been carried out at different temperatures using carbon electrodes. The yield of hydrocarbon is maximum at a certain optimum temperature of 59°C. Free radicals generated during electrolysis of sodium acetate has been utilised to induce polymerization of methyl methacrylate. A spongy polymer was obtained at the anode. The polymer is insoluble in Benzene, Petroleum Ether and Chloroform obviously due to cross linking.

125. Viscosity of solution of Nickel Sulphate in Dioxane-water mixture at 35°C.

N. K. HOTA, P. K. DAS and D. PATNAIK.

The measurement viscosity of Nickel Sulphate in 10%, 20%, 30% and 40% by weight of dioxan-water mixture has been carried out to verify the modified Jones and Dole equation suggested by us (Curr. Sci. 1956, 25,337). The experimental data for 10% and 20% composition fit in well with the modified Jones and Dole equation where as, for 30% and 40% composition mixtures the equation does not hold good. The weak electrolytic behaviour, of Nickel Sulphate due to ion association and incomplete dissociation arising out of the decrease in dielectric constant has been considered as the reasons for the non-applicability of the modified Jones and Dole equation.

126. Some interesting results in the study of Depolarization Kinetic of a Palladized electrode.

H. P. AGARWAL and R. S. VAIDYA, Bhopal.

The depolarization potential time curves obtained for the same concentration of all the oxidants, show that the halting region for the first inflexion decreases in order of the extent of depolarising action of the oxidant, i.e., Potassim dichromate<potassium permanganate<ferric ammonium sulphate. The palladized electrode seems to be more sensitive to the action of depolarizers as compared to platinized electrode, which fails to show that potassium dichromate is a better depolarizer than potassium permanganate.

The time for first inflexion varies linearly with inverse of concentration of the oxidant, therefore the concentration of any solution of unknown strength can be determining from such plots, provided the depolarization time corresponding to the first inflexion is known.

127. Studies in Vinyl Polymerization using metallic soaps as initiators—Polymerization of Methyl Methacrylate using Ferric Laurate as catalyst.

V. LINGAMURTY, Calcutta.

The study of metallic soaps as initiators of vinyl polymerization has been undertaken in view of the increasing technical application of metals as catalysts in producing isotactic and other sterically ordered polymers initiated by Van Natta and Ziegler. The polymerization of methyl methacrylate using ferric laurate as catalyst has been studied. The initial rate of polymerization increases rapidly with increasing catalyst concentration, attains a maximum value and slowly falls down to a very low value at high concentration of the ferric soap. The fatty acids like oleic and lauric acids have practically no effect on the polymerization of methyl methacrylate, thus showing that the entire role is played by the metallic part of the soap. Also, soap-catalysed polymerization of methyl methacrylate is susceptible to inhibition by hydroquinone and fails to give any test for the reduction of ferric ion to the ferrous stage. The degree of polymerization seems to be abnormally high. Oxygen seems to be a co-catalyst at low concentration of the soap. All the above mentioned unusual features distinguish this catalyst from the hitherto known types of catalysts used in vinyl polymerization. A tentative mechanism basically of the free radical type, but with a few additional characteristics has been proposed.

128. The effect of temperature on the Polymerization of Ethyl Methacrylate.

S. N. KHANNA and S. R. CHATTERJEE, Calcutta.

Ethyl methacrylate has been polymerized in bulk by employing 2-2′ azobis-isobutyronitrile as initiator within a temperature range of 45° to 100°C. Yield curve is a straight line, passing through origin, showing thereby the absence of inhibition period. The rate of polymerization was found to be proportional to the square root of the catalyst concentration, over a forty fold increase in the concentration of the initiator.

The rate constant δ $(=Kt^{\frac{1}{2}}/Kp)$ at temperatures 45°, 50°, 60°, 80°, 90° and 100°C are 11·04, 9·43, 7·33, 5·29, 4·48 and 4·10 respectively, having an energy of activation $(Ep-\frac{1}{2}\,Et)$ 4·22 kcals. This value of energy of activation is comparable to that of methyl methacrylate which is 4·40 kcals. The efficiency (f) of catalyst used was found to be between 0·5 and 0·7 in the range of temperatures of experiment, proving the independence of efficiency with temperature.

129. Kinetics of Hydrolysis of Peroxy Titanium Sulphate.

M. S. MOHAN and C. C. PATEL, Bangalore.

Peroxy titanium sulphate (TiO_2SO_4, $3H_2O$) is found to undergo hydrolysis in dilute aqueous solutions resulting in the precipitation of a mixture of hydrated titanium peroxide and titanium dioxide. The kinetics of hydrolysis have been studied at 0°, 25° and 35°C. by the spectrophotometric method. The reaction is found to be very rapid during the first few minutes and is slowed down considerably thereafter due to a fall in pH. The high values obtained for the orders of reaction indicate that the reaction is complex. pH measurements show that during the initial period hydrogen ion concentration changes at a faster rate than the precipitation of the hydrolysed products but on prolonged hydrolysis the overall rate of precipitation of titanum oxides approaches the change of pH of the solution. These results are explained on the basis of the co-ordination theory of multivalent metallic hydroxides.

130. The Study of the effect of temperature on the decomposition potential of fused salts.

M. G. KHER and P. S. MENE, Nagpur.

The effect of temperature on decomposition potential of a fused $NaCl\text{-}AlCl_3$ bath has been determined. Model Ratio of $NaCl\text{-}AlCl_3$ has been used in all the experiments. The temperature range for which the experimental work was carried out is 300°C to 660°C. The decomposition potential has been found for $C/NaCl\text{-}AlCl_3/C$ system. It has been observed that effect of temperature on the decomposition potential is a linear function since a plot of decomposition potential vs. temperature gives a straight line. A mathematical expression of the type $E_t=E_0(1-\alpha t)$ could be used to obtain the value of decomposition potential at any temperature, within the range studied. The value of 'α' determined is ·000585.

131. Heterogeneous Reaction between Chromium Sesquioxide and Potassium Bromate.

C. R. TALPADE and P. T. WAD, Bombay.

The reaction between chromium oxide and potassium bromate solution was studied with change of temperature, mass of chromium oxide, concentration of potassium bromate solution, pH, dilution, and the addition of bromine.

It is found that increase of temperature, mass of chromium oxide, or concentration of potassium bromate promotes the reaction, while decrease of pH catalyses the reaction. The solute molecules are first adsorbed by chromium sesquioxide, which then starts reacting with the adsorbed molecules.

132. A study of conductivity of the systems: Water—0.2N Sodium Salts of fatty acids and alcohols in presence of free acids or alkali.

A. N. BOSE and K. N. MEHROTRA, Lucknow.

For the systems "Water—0·2N sodium salts of fatty acids and alcohols (3-methyl butanol-1 or hexanol-1) in presence of free acids and sodium hydroxide" the specific conductivity decreases with the increase in the chain length of the soap as well as of the alcohol. The specific conductivity of the solutions increases with the increase in sodium hydroxide concentration. In the plot of specific conductivity—sodium hydroxide concentration, the curvature is more marked in the cases of lower soaps than the higher soaps.

133. A study of conductivity of the systems: Water—0.2N Sodium Salas of fatty acids and Butanol-1 in presence of free acids and alkali (Part III).

A. N. BOSE and K. N. MEHROTRA, Lucknow.

For the system : "Water—0·2N sodium salts of fatty acids and butanol-1 containing free sodium hydroxide" the specific conductivity increases with the increase in sodium hydroxide concentration for all the soaps. In the plots of specific conductivity—sodium hydroxide concentration, the curvature is more marked for 5% butanol-1 solutions than for 10%. In the case of lower soaps the curvature is more marked than in the case of higher soaps.

The specific conductivity of the solutions decreases with the increase in butanol-1 concentration for all the soaps.

134. Autoprotolysis constant of Ethylene glycol.

KIRON KUMAR KUNDU, Jadavpur.

The autoprotolysis constant K_S of amphiprotic solvents such as water, ethanol. glycol, or the like is a significant quantity in the studies of ionization of acids and basis in those solvents.

The autoprotolysis constant of ethylene glycol has been determined at 30°C by following the method of Hammett and Dietz employed for formic acid medium. The method involves the titration of hydrochloric acid solutions in ethylene glycol against sodium glycoxide in the same solvent and measurements of potentials on both sides of the inflexion point to a considerable extent with the help of a cell of the following type :

$$\text{Pt; } H_2 \text{ (gas), HCl in glycol, AgCl (solid); Ag.}$$

The value of the autoprotolysis constant (K_s) has been calculated from the equation :

$$-\log K_S = \frac{E_{ab}}{2{\cdot}303\ RT/F} - \log C_a \times C_b$$

where C_a is the molar concentration of the unneutralised acid and C_b the molar concentration of the base present in excess at two point on either side of the inflexion point on the titration curve and E_{ab} the difference in the measured e.m.f. corresponding to these two points.

The value of K_S at 30°C is found to be $1{\cdot}64 \times 10^{-15}$,

135. The Kinetics of the Formate-persulphate reaction : Part I.

K. BAKSHI and D. PATNAIK, Cuttack.

The kinetics of the uncatalysed formate-persulphate reaction has been studied by Srivastava and Ghosh who found the reaction to be unimolecular, while Kappanna observed the reaction to be bimolecular. The facts observed by us are that the reaction is not an homogeneous one and it shows periodicity, indicating the possibility of chain mechanism involving radicals. Accepting the postulate of formate radical as suggested by Kappanna and decomposition of persulphate ion to two sulphate ion-radicals, we have put forward a mechanism which explains the anomaly stated above. The rate determining stages of the mechanism involve uncharged species for which the rate becomes independent of ionic strength. The decrease of the rate with increase in ionic strength as noted by others has been attributed to the ion-pair formation and incomplete dissociation of the reactants at high ionic strengths. The effect of different ions has been explained in terms of the interaction of these ions with the radicals. While all the features of this reaction have been elucidated by our mechanism, its heterogeneous character explains for the reproducibility of the rate only under the working conditions set by any particular investigator and for the susceptibility of this reaction to impurities.

136. Studies on the Dissolution of Arsenic Sulphides in Sodiumhydrosulphide.

MAN HARAN NATH SRIVASTAVA and SATYESHWAR GHOSH, Allahabad.

In the present paper the dissolution of arsenic tri and penta sulphides in sodium hydrosulphide reagent has been studied systematically by analytical, conductometric and potentiometric methods. The equation $\frac{(m-xa)^x}{(n-xb)} = a/b$ has been applied to evaluate factor x to determine the composition of the complex formed, and by the knowledge of this the Formation Constants (K) have been calculated by the help of the equation $\frac{[a]}{[m-xa]}x = K$. It was observed that in both cases of arsenic tri and pentasulphides the value of $x = 0{\cdot}5$. Thus the results indicate that in this case along with HS water molecules also take part in the process of dissolution and instead of pure thio anions thio-oxy anions are formed.

$$As_2S_3 + H\bar{S} + 4\ H_2O = 2\ AsS_2O_2{}^{5-} + 9H^+$$
$$As_2S_5 + H\bar{\bar{S}} + 2\ H_2O = 2\ AsS_3O^{3-} + 5H^+$$

The values of K have come out to be 0·6521 (As_2S_3) and O·5010 (As_2S_5).

It has been further observed that the solutions containing dissolved arsenic pentasulphide in NaHS on acidification produce an immediate precipitate of arsenic tri sulphide and sulphur. The reason is that trisulphoxyarsenic acid (H_3AsS_3O) is very unstable, and decomposes immediately into disulphoxyarsenious acid and sulphur, which in turn produces a precipitate of As_2S_2.

137. Dissolution Studies of Molybdenum Sulphide.

MAN HARAN NATH SRIVASTAVA and SATYESHWAR GHOSH, Allahabad.

In earlier publications results have been reported on the dissolution studies of arsenic sulphides in alkaline hydrogen sulphide solutions and sodium hydrosulphide. The present paper deals with a similar study on molybdenum sulphide. It has been observed that in this case dissolution occurs mainly through the action of sulphide ions forming a series of thiomolybdate anions viz. MoS_4'', $MoS_6{}^{6-}$, $MoS_8{}^{10-}$ etc. The equation $\frac{(m-xa)}{(n-xb)}$ $x=a/b$ has been applied to elucidate the composition of the complex ions formed, and it has been clearly established that different thioanions are formed during the dissolution of molybdenum sulphide, because different values of the factor x (x = 1, and 1·5) were obtained for the different ranges of dissolution. The formation constants (K) were calculated to be 0·1275 and 0·08548 respectively. It was further observed that in the overall dissolution of molybdenum sulphide no hydroden ion is liberated. Thus the reactions may be represented to occur as :

$$MoS_3 + S^{2-} = MoS_4{}^{2-}$$
$$MoS_3 + 3S^{2-} = MoS_6{}^{6-}$$
$$MoS_3 + 5S^{2-} = MoS_8{}^{10-}$$

138. Kinetics and mechanism of acid-catalysed Phenol-formaldehyde reaction.

LOURDU M. YEDDANAPALLI and A. K. KURIAKOSE, Madras.

The kinetic study of the primary steps in the acid-catalysed phenol-formaldehyde reaction has not so far been investigated probably due to the occurrence almost from the beginning of the reaction of di- and higher nuclear products along with methylol phenols.

By a judicious choice of the concentrations of the reactants and catalyst, it has been possible to limit the reaction to the production of o- and p-metehylol phenols, o,o′-, o,p′-, p,p′-dihydroxy diphenyl methanes. Although the reaction at constant acid concentration giving all these products, is in reality kinetically of second order, at excess phenol concentration it exhibits first order kinetics.

With excess phenol and 0 1 N sulphuric acid at 80°, the first order rate constants for the formation, from o-methylol phenol, of o,o′-, and o,p′-dihydroxy diphenyl methanes are $3{\cdot}60 \times 10^{-5}$ and $30{\cdot}40 \times 10^{-5}$ sec^{-1} resp. Under the same conditions the rate constants for production of o,p′- and p,p′-dihydroxy diphenyl methanes from p-methylol phenol are $9{\cdot}60 \times 10^{-5}$ and $59{\cdot}30 \times 10^{-5}$ sec^{-1}. With the help of these rate constants, the constants for o- and p-methylol phenols from phenol and formaldehyde are found to be $1{\cdot}40 \times 10^{-5}$ and $1{\cdot}91 \times 10^{-5}$ sec^{-1} resp.

Explanation is offered in terms of steric and electronic factors for the greater reactivity of the para compared to the ortho position in phenol both in addition and condensation reactions, and for the much higher rates for the condensation than for the addition reactions.

139. Studies on the coagulation of colloids with special reference to the variation of time of coagulation with concentration of electrolytes as applied to Prussian Blue sol.

S. L. GUPTA, Pilani.

This piece of work relates the slow coagulation of prussian blue sol by various Uni-bi-ter and tetra valent precipitating ions. The results obtained with various electrolytes are interesting enough to provoke thought on the aspect of slow coagulation in the light of the empirical equation, $c = a + \frac{m.\,1/t}{n + 1/t}$, suggested by Bhattacharya and co-workers, where 'c' is the precipitation,—concentration of the electrolyte; 't' is the time of coagulation and 'a', 'm' and 'n' are constants which depend on such factors as are connected with its stability and coagulation. This equation represents a rectangular hyperbola and it is interesting to find that the graphs of c against 1/t drawn from experimental results are indeed of hyperbolic nature. A method for the evolution of the values of the constants is also given.

140. Structure and absorption of some vat dyes.

ARUN KUMAR SINHA, Patna.

The absorption of twenty-eight vat dyes (reported elsewhere) have been recorded.

An attempt has been made to study the shifts in their absorption maxima in the light of the molecular structures of the dyes.

141. A reaction between Iodine and Sodium thiosulphate in Heterogeneous liquid—liquid system in the presence of a Surface-active agent.

P. S. JAVADEKAR, Sangli.

A reaction between Iodine solution in Chlorobenzene and aqueous Sodium thiosulphate is studied in the present investigation. The velocity of a reaction in such a system is dependent on the concentration of the reactants at the inface. A foreign material which is able to affect the interfacial tension is also bound to affect the velocity of the reaction. Soap is, therefore added to the aqueous phase. The velocity constants are rapidly increased by the addition of soap. The velocity constants are 20·2; 61·8; 72·4; 83·2 and 94·3 by the addition of 0; 1; 2; 3; and 4 grams of soap respectively to the aqueous phase. The values are almost constant in the absence of soap, but they remarkably increase especially during the first 30 minutes by the addition of soap. It is clear, therefore, that as the soap is being consumed from the aqueous phase the concentration at the interface also rapidly changes.

142. The Electrical Conductivity of Silica Sols.

M. J. PATANI, P. J. PATANI and A. M. TRIVEDI, Ahmedabad.

Negatively charged silica sols are prepared by peptizing the purified silica gel, with ammonia. When the sols are allowed to age, the sp. conductivity of the sol increases due to the deadsorption of ammonium silicate. Although ammonium silicate is a salt of a weak base and a very weak acid, it is not completely hydrolysed under the conditions of the experiments. The adsorbed ammonium silicate behaves as a colloidal electrolyte and its eq. conductivity is a fraction of its value in the free condition.

143. Molecular interaction in Binary Mixtures.

S. N. BHATTACHARYYA and A. V. ANANTARAMAN, Calcutta.

The excess volume of mixing has been determined for the following systems—Nitrobenzene+Benzene; Nitrobenzene+Ethylbenzene; Nitrobenzene+cyclohexane at 40°C. While the excess volumes of Nitrobenzene+Benzene and Nitrobenzene+Ethylbenzene are negative, the system Nitrobenzene+cyclohexane shows a positive character.

All the systems show deviations from the regular solution theory of Guggenheim as expected. It may be noted that one of the components selected in all the systems is highly polar. The excess of volume of mixing can perhaps be explained from the point of view of either a partial destruction or formation of dipolar interactions between the molecules involved.

The excess volume could be represented by the following equations :—

Nitrobenzene + Benzene

$$\frac{\Delta V}{x_1 x_2} = -1{\cdot}022 + {\cdot}093 \ (x_1 - x_2) + {\cdot}857 \ (x_1 - x_2)^2$$

Nitrobenzene + Ethylbenzene

$$\frac{\Delta V}{x_1 x_2} = -1{\cdot}37 + 1{\cdot}15 \ (x_1 - x_2)^2$$

Nitrobenzene + Cyclohexane

$$\frac{\Delta V}{x_1 x_2} = 1{\cdot}24 + {\cdot}185 \ (x_1 - x_2) - 966 \ (x_1 - x_2)^2$$

144. Relationship between sound carrying pressure and internal pressure of pure liquids.

SATISH CHANDRA SRIVASTAVA and R. J. R. MOHANRAO, Calcutta.

Maximum positive and negative pressure, during the passage of ultrasonic waves through liquids, is called here as sound carrying pressure. This has been found to bear approximately a relationship with the internal pressure of the liquid which has been discussed. This equation may find application in the derivation of an equation for the velocity of ultrasonic waves in solution especially solutions of Electrolytes.

145. The System Lithium Nitrate-water.

G. ARAVAMUDAN and K. R. KRISHNASWAMI, Bangalore.

The solubility and phase relationships in the system $LiNO_3$-H_2O have been studied in the range 10-55°. Physical and Chemical methods of investigations employed in the present work pointed to the non-existence of the hemihydrate, $LiNO_3.1/2\,H_2O$, reported by Donnan and Burt to exist between 29·6° and 61°. The melting point of the trihydrate, $LiNO_3.3H_2O$, has been found to be $30{\cdot}07 \pm 0{\cdot}02^\circ C$. and the eutectic between $LiNO_3.3H_2O$ and $LiNO_3$ as $28{\cdot}24 \pm 0{\cdot}02^\circ C$. The trihydrate crystal belongs to the orthorhombic system and its lattice constants have been determined. Some observations made on supersaturation and supercooling tendencies and other specific properties of the binary system have been reported.

146. A study on the viscosity of Sodium Chloride in dioxane-water mixtures at 35°C.

P. K. DAS, Cuttack.

Measurements of viscosity of Sodium chloride in dioxane water mixtures have been carried out to verify the modified Jones-Dole equation (Curr. Sci., 1956, 25, 337). The concentration of the electrolyte varied from 0·02M to 0·12M and the solvent composition from 10% of dioxane to 30% of dioxane. It is found that the modified equation is obeyed for 20 and 30% solvents, whereas, for solvent containing 10% of dioxane the Jones Dole equation as such is valid. The decrease in the value of 'X' of the BC term with increased dioxane content has been attributed to be due to increased chances of ion-association in the mediums of lower dielectric constant.

Change in the value of 'B' with change in composition of the solvent has been noticed, as in case of KCl solutions. The results when compared with that of KCl attributes an additive character to B, in solvents of low dioxane content.

147. Application of Phase rule to Sambhar Lake Bitterns.

C. R TALPADE and D. M. PETHE, Bombay.

The solubility data with respect to the sodium salt present in the Sambhar Lake Bitterns has been collected at 35° and 45°. On the basis of this data, a method has been suggested for the separation of these salts from each other. Still it may not be economical to separate out these salts because of the low cost of the salts so obtained.

148. Mixed Liquid Crystals : Effect of Structure on the Transition Temperatures of Mixed Liquid Crystals.

J. S. DAVE and J. M. LOHAR, Baroda.

A number of binary systems in which one component can itself form liquid crystal were studied by Dave and Dewar (J.C.S., 1954, 4616; ibid, 1955, 4305). They showed that genuine mixed liquid crystals are formed with any other non-liquid-crystalline substance over a useful range of concentration. They studied mixtures of p-azoxyanisole, a liquid crystalline substance, with another non-liquid crystalline component—(Schiffs' bases) having terminal groups H, CH_3, OCH_3, Cl, Br, NO_2 and $N(CH_3)_2$—and concluded that the slope of the transition line is a measure of the tendency of the non-liquid crystalline component to form liquid crystals.

We have, during the course of present investigation, studied some more such binary systems, with p-azoxyanisole as a liquid crystalline component, by the optical method. In addition to the terminal groups listed above, we have studied the the effect of OH and OC_2H_5 groups. The slope of the curve for the OC_2H_5 group is less than that of OCH_3 group, thus showing an increased tendency of OC_2H_5 group for liquid crystal formation. Our results indicate that the slope of the transition line decreases with increasing polarity of the end groups.

149. Excess volumes of some binary liquid mixtures.

KIRON KUMAR KUNDU, Jadavpur.

Excess volumes of binary liquid mixtures are proved to be useful quantities in evaluating some of the thermodynamic properties of liquid mixtures, namely, energy of mixing and hence solubility parameters ($\Delta\delta_{12}$) of binary liquid mixtures from heat of mixing data, excess entropy of mixing at constant volume etc. Volume changes of mixing or excess volumes (since $v^e = \Delta V^M_{soln} - \Delta V^M_{ideal\ soln}$ and ΔV^M for ideal solution is zero) of several binary liquid systems namely, (1) acetonitrile and carbon tetrachloride, (2) acetonitrile and benzene, (3) nitromethane and benzene, (4) nitromethane and carbon tetrachloride have been determined at intervals over the whole composition range at 45°C and (5) nitromethane and acetonitrile at 35°C.

150. Studies in Electrodes of the Third Kind.

J. N. SAHAY, Ranchi.

The activity coefficient of calcium chloride has been determined with the following electrodes of the third kind which behave reversibly with respect to calcium

(a) Pb /$PbSO_4$, $CaSO_4$ /$\underset{(m)}{CaCl_2}$/AgCl/Ag
(b) Pb-Hg/PbC_2O_4, CaC_2O_4 /$\underset{(m)}{CaCl_2}$/AgCl/Ag
(c) Hg /$Hg_2C_2O_4$/CaC_2O_4 /$\underset{(m)}{CaCl_2}$/AgCl/Ag
(d) Zn /ZnC_2O_4/CaC_2O_4 /$\underset{(m)}{CaCl_2}$/AgCl/Ag

It has been observed that for every electrode of the third kind cell should be designed as in this case to maintain strictly oxygen free condition as oxygen renders the electrode unreliable. Freshly prepared pure materials should also be used. If there be other anions present even in small amount to form other insoluble salt or other cations to form insoluble oxalates the theoretical equilibrium will not be reached and reproducible E.M.F. is not obtained. Generally, the cell reached equilibrium after taking four or five readings at interval of ten minutes. Electrodes of this type employing single concentration cell in dilute solutions are useful in determining the activity of metallic ions, the metal of which cannot be used as electrode of the 1st or 2nd kind owing to their reactions with aqueous solutions. The results obtained by the use of electrode of the third kind are in agreement with those found by other methods.

151. Studies on the composition of Mercury(ic) ferrocyanide complexes by Thermometric method.

RAM SAHAI SAXENA and G. S. BHATNAGAR, Kota.

In continuation of our previous publications on the composition of Mercuric ferrocyanide complexes by electrometric methods (Saxena and Bhatnagar, Zeit. anorg. und allg. Chemie, *285*, 95, 1956; Naturwissenschaften, *45*, 128, 1958), attempts have been made to substantiate these results by applying Dutoit's method of thermo-volumetry.

The arrangement of thermometric titrations was similar to that used by Dutoit (J. Chim. Phys., 1922, *19*, 324) and later on modified by Haldar (Jour. Indian Chem. Soc., 1946, *23*, 157). Using different concentractions of reactants, $HgCl_2$ and $K_4Fe(CN)_6$, thermometric titrations were done both by the direct and the inverse methods, i.e., when $HgCl_2$ soln. from the burette was added to $K_4Fe(CN)_6$ soln. in the thermo-flask and vice-versa. The total rise in temp. was then plotted against the volume of the titrant and from the breaks in curves, the composition of complexes was calculated.

The direct thermometric titration diagrams yield three distinct breaks corresponding to the formation of the compounds, $K_2HgFe(CN)_6$; $Hg_2Fe(CN)_6$; and an additive compound $Hg_3Fe(CN)_6.Hg(Cl_2)_2$; whereas the inverse titrations suggest the formation of only two complexes $Hg_2Fe(CN)_6$ and $Hg_2Fe(CN)_6.K_4Fe(CN)_6$. The formation of these complexes has been supported by electrometric methods (loc. cit.).

152. Conductrometric studies on Silver Tungstates.

R. S. SAXENA and C. M. GUPTA, Kota.

According to W. Jander and A. Winkel (Zeit. anorg. Chem., *149,* 97 (1930)) normal WO_4^{--} ion exists from H ion concentration 10^{-14} to $10^{-6.5}$ but the acidic medium, the formation of more complex anions takes place, depending on pH of the medium. (Emeleus and Anderson : 'Modern aspects of Inorganic Chemistry', 1952, p. 213). In the present investigation, attempts have been made to study the formation and precipitation of Ag-tungstates at different H ion concentration of solution by conductometric method, conductivities being measured by Kohlrausch Universal Bridge (W. G. Pye, Ltd.).

When $AgNO_3$ is added to Na_2WO_4 at pH range from 7 to 14, and reverse, normal Silvertungstate $Ag_2O.WO_3$ is formed. In weakly acid solution pH 5·5—7, the formation precipitation of Silver ditungstate $Ag_2O.2WO_3$, takes place. Further addition of acid to Na_2W_4 at pH ranging from 4 to 5, silver meta tungstate $Ag_2O.4WO_3$ is precipitated. The results of Chemical analysis agree with the above.

The effect of alcohol on the end point has also been studied, Alcohol improves the results and the equivalence points approach closely to the theoretical values, in presence of alcohol which materially reduces the solubility of silver tungstate.

153. Conductometric Studies on Copper-tungstates.

R. S. SAXENA and C. M. GUPTA, Kota.

In alkaline solution, normal tungstate ion exists but in acidic medium, formation of more complex anions takes place, depending on the pH of the medium according to G. Jander and U. Kruerke (Z. anorg. u. allgem. chem., 1951, *265,* 244-54). A systematic study of the formation and precipitation of copper tungstates has been undertaken by conductometric methods, conductivities being measured Kohlrausch Universal Bridge (W. G. Pye, Ltd.).

When $CuSO_4$ is added to Na_2WO_4 and reverse, normal copper tungstate $CuO.WO_3$ is precipitated from pH 6 to 8. Suitable amounts of nitric acid were added to Na_2WO_4 solution and pH was measured by a glass electrode. On adding $CuSO_4$ to such Na_2WO_4 solution, a sharp break in conductivity curves is obtained suggesting the formation and precipitation of Coppermetatungstate having the composition $CuO.4WO_3$ between 4·8 to 5·5. Conductometric results agree with those obtained by chemical analysis.

The effect of alcohol has also been studied on the end point. The equivalence point in alcohol approach closely the theoretical values, as it materially reduces the solubility of Coppertungstates.

154. Stability of metal complexes in solution.

B. N. MATTOO, Poona.

With a view to account for various competing equilibria in the study of ferric complexes in solution, especially when the metal perchlorate is not used, a potentiometric study of ion association in ferric sulphate and nitrate solutions has been undertaken. At low Fe III concentration, from redox potential measurements in presence of varying amounts of anions (Fe II/III in inert atmosphere) the formation functions, m's (Cf. Mattoo, *Z. physik. Chem. Neue Folge, 16* (1958) 64) were evaluated and fitted into the general equation $m_l - \beta_l = \sum_{1}^{n} x_n(R)^n$, where β_l is the appropriate correction term for competing equilibria and x is the n-th overall association 'constant', (R) the free anion concentration, which in the case of SO_4^{2-} was evaluated from the knowledge of $K_{HSO_4^-}$ at the particular ionic strength. This was evaluated by pH measurements of $NaClO_4$-$HClO_4$-Na_2SO_4 mixtures.

A graphical examination of the affinities of various simple anions for $Fe^{3}+$ and the proton affinities of these anions ($\triangle G^{o}_{FeR} - pk^{o}_{HR}$) shows that the two go parallel

155. The Ultraviolet Absorption Spectra of some Natural Coumarins.

D. P. CHAKRABORTY and SACHINDRA K. CHAKRABORTI, Calcutta.

The ultraviolet absorption spectra of the following natural coumarins and some of their derivatives were determined.

Murrayin, angelicin, bergapten, xanthotoxin, byakangelicin, marmesin, luvangetin, seselin, dalbergin, nor-dalbergin, weddelolactone, mesuol, tetrahydro mesuol, dimethyl mesuol, tetrahydro dimethyl mesuol.

It has been observed that furano coumarins show a characteristic absorption band with λmax at 245 mμ region (log ε *Ca.* 4) chromeno-α-pyrones show a characteristic absorption band with λmax at 268 mμ region (log ε *Ca.* 4). The spectral data have been discussed in the light of the structures of coumarins.

156. Absorption Spectra of the Oximes.

J. V. DAVE and A. M. TALATI, Baroda.

Ultraviolet absorption spectra of α-oximino and α-β-dioximino-acetoacet(aryl) amides (where arylamide may be anilide, o-toluidide, o-chloranilide, o-anisidide, p-chloranilide, p-phenetidide or 2 :4-xylidide have been investigated in acqueous, alcoholic and chloroform solutions. These oximes are found to absorb maximally in the region 224-46 mμ in aqueous and alcoholic solutions. α-Oximine acetoacet (aryl) amides in aqueous solution exhibit another absorption band in the region 260-84 mμ. Comparative study of the absorption bands of oximes in aqueous and alcoholic solutions indicate the existence of internal hydrogen bond in these oximes. Some of the oximes in chloroform solutions are found to have absorption bands in the region 290-340 mμ.

157. A simple probe Electrode for comparative study of current distribution at surfaces.

INDRA SANGHI and V. R. RAMANATHAN, Karaikudi.

The study of electrochemical phenomena depends on careful and accurate measurements of potentials and currents at different points of the electrode surface. So far, attention has mainly been concentrated on the study of potential distribution on electrode surface with the help of a Luggin capillary. The study of varying current distribution at polarized electrodes covered with surface layers varying in nature or thickness has almost been neglected due to the difficulties inherent in such measurements. The importance of the study of current distribution was brought home during a study of electropolishing in Hull cell where the surface potential studies failed to explain the observed facts. As such, a simple probe electrode for comparative study of current distribution at surfaces was designed and this note describes the construction and the working of the same. The probe-electrode consists of a thin perspex rod with a small hole at one end. Single wire loops, forming a reversible electrode system in the particular electrolyte, are attached across this hole with a joining comment. The iR drop between the loops of the two wires when the probe electrode is placed in the vicinity of different points at the electrode surface, gives a comparative measure of the current distribution. This probe arrangement gave useful information which was successful in explaining the observed phenomena.

158. Thermal conductivity and Eucken correction for Binary Gas mixtures consisting of a Monatomic and Diatomic Gas.

B. N. SRIVASTAVA, Calcutta and R. C. SRIVASTAVA, Lucknow.

The thermal conductivity of the binary gas mixture H_2-Ne, N_2-He and O_2-He has been measured at 38°C for various concentrations by using the 'thick wire' variant of the 'hot wire method'. These data have been used to calculate the Eucken factor for these binary gas mixtures. The experimental value of the thermal conductivity and Eucken factor have been compared with the theoretical values obtained on Lennard Jones (12 :6) model, by using Hirschfelder's recent expressions for the thermal conductivity and the Eucken factor for the polyatomic gas mixtures. It is found that within the limits of accuracy of the experimental measurements Hirschfelder's expressions for the thermal conductivity of a gas mixture is correct.

159. Quantum Theory of the Kinetics of Thermal and Photochemical Reactions.

PREM BEHARI MATHUR, Pilani.

A relation for velocity constant of chemical reactions ($K = e.\ e\ D^{\circ}o/RT$) has been obtained in terms of spectral quantities $D^{\circ}o$ Ed and A. The equation besides explaining the much conjectured mechanism of chemical reactions enables the calculation of spectral data and other molecular constants as force contant etc. purely from chemical data and vice versa. A striking fact regarding the equation is that the values of $D^{\circ}o$, Ed and A evaluated from chemical data always lie within certain limits that represent an active range of electromagnetic frequencies. The equation throws light on the structure, activity and bond forces of the molecules.

160. Classification of the different systems of periodic precipitations.

PREM BEHARI MATHUR, Pilani and SATYESWAR GHOSH, Allahabad.

Several types of Liesegang ring systems have been obtained and the conditions of their formation are studied. By properly adjusting the environmental conditions, all these different types of periodic precipitations have been produced from silver chromate alone. A new system of Liesegang rings having alternate coloured band, at the beginning followed by void-spaced rings is obtained from the precipitate of silver chromate in a gel mixture of agar and gelatine. The observations definitely prove that all such rhythmic precipitations are one or other form of Liesegang ring phenomena. On the consideration of the nature of bands, the periodic precipitations are classified into the categories (a) Direct and Revert systems (b) Macro and Micro systems and (c) Void spaced and Continuous banded systems. Previous attempt of classification of Liesegang ring systems, however, does not assess all the different characteristics of rings.

161. Note on the Analogy between Diffusion and the Flow of Electrical Current.

PREM BEHARI MATHUR, Pilani.

On the basis of Longworth observations on diffusion and authors own observations on the growth of Liesegang rings, a theory of diffusion has been advanced which shows a unique parallelism between diffusion and the discharge of electricity or any other phenomena of damped harmonic motion. A wave equation for the concentration distribution of diffusate has been obtained. The equation is found to satisfy experimental conditions in Leisegang ring phenomena very well. The equation is also applicable to certain geological phenomena. The author believes that the evolution of continents over earth face can most successfully be explained from the present theory of diffusion.

162. A Theory of Surface Catalysis.

PREM BEHARI MATHUR, Pilani.

From the experiments carried out on the catalytic oxidation of ammonia and on the measurement of Zeta potentials of the active surfaces using pure water as a reference substance, the author has been able to notice an interesting relationship between the interfacial potentials and the catalytic activity of the substances. The sign and magnitude of the potentials are found to vary in a regular order with the activity of the catalyst. On the basis of these observations, the author has been able to advance a theory for the surface catalysis which not only explains the specific catalytic nature of a substance in a particular reaction and the influence of foreign agents on catalysts surface but is capable of predicting efficient catalyst for any reaction. The substances have been classified into two catagories and the activity of a catalyst in different reactions is explained in the light of their characteristic surface potentials.

163. Hydrogen Bonding in Dioxan-Water Mixtures : Partial Molar Volumes and Molecular Interaction.

V. R. KRISHNAN and P. RAMACHANDRA NAIDU, Tirupati.

The partial molal volume of p. Dioxan in mixtures with water has been used for the study of molecular interaction between the components in the liquid phase. While the partial molal volume differs appreciably from the molar volume of the pure component up to mol fraction 0 14 dioxan the agreement between the two is close at higher concentrations. Support has been provided for the postulated existence of the short range molecular clusters between dioxan and water through hydrogen bonding with the molecular ratio 1 :6. The effect of change of composition on the nature of molecular association is discussed.

164. Mechanism of Dehydrogenation of 3-Carene by Chromia Alumina-catalysts.

LOURDU M. YEDDANAPALLI and P. DESIKAN, Madras.

3-Carene was dehydrogenated in the vapour-phase over chromia supported on gamma-alumina catalysts to p- and m-cymenes whose relative amounts varied with the chromium content of the catalyst. The para : meta cymene ratio was 1·0 :1·5 for catalysts containing 6% or less of Cr, and with catalysts containing 7—18% Cr, 1·0 :0·8.

Gamma-alumina alone isomerised 3-carene to 4-carene at 200°C (55% yield), and at 300°C to p- and m-menthadienes completely in the ratio, 1·0 : 1·67. On the other hand, pure chromia gel dehydrogenated 3-carene to p- and m-cymenes in the ratio, 1·0 : 0·6.

On the basis of the above observations, it is suggested that the aromatisation of 3-carene to p- and m-cymenes proceeds in two different ways : (1) first isomerisation to 4-carene, then to p- and m-menthadienes and finally dehydrogenation to p- and m-cymenes in the ratio 1·0 : 1·67 (predominent with catalysts of 6% or less Cr content), and (2) first dehydrogenation to caradiene intermediates which then rearrange to p- and m-cymenes in the ratio 1 0 : 0 6 (in the case of Cr rich catalysts). The anomalous behaviour of the 14% Cr catalyst in respect to m-cymene yield is explained by reference to co-precipitated chromia-alumina catalysts.

165. Action of Iodine an α-Cellulose under various Physico-chemical conditions.

R. NARAYAN RAO and C. S. NARWANI, Bombay.

Cotton yarn of 20s counts made from an Indian cotton was boiled under controlled conditions in a kier to free it from all noncellulosic constituents and bleached, and this sample was employed for all experiments.

The action of N/50 iodine solution in KI on this α-cellulose at pH 3·0 to pH 7·0 was studied at 15°C and the copper number and carboxylic acid groups were estimated. It was observed that there was no chemical reaction under these conditions and only sorption was taking place.

In further experiments on sorption, the rates of sorption at three different temperatures, viz., 0°C, 15°C and 37°C and at two pH conditions, viz., pH 4·0 and pH 6·0 have been studied. It has been found that sorption of iodine by cellulose is rapid in the initial stages and equilibrium is reached after a few minutes. The sorption isotherm (i.e. sorption *vs.* Equilibrium concentration) and sorption isobar (i.e. sorption *vs.* temperature) have also been studied.

At higher pH conditions, viz., pH 8 0 to pH 13 0, the hypoiodite formed in the reaction of iodine with alkali reacts with cellulose. The copper number remains more or less the same upto pH 9·0, increases rapidly thereafter upto pH 11·0 and again falls down to the original value at pH 12 0 and pH 13·0; but the COOH increases gradually upto pH 11·0 whereafter it decreases gradually. This indicates that a number of aldehyde groups is oxidised to -COOH in all cases, but at pH 10·0 and pH 11·0 a few of the alcoholic groups are oxidised to -CHO groups. Besides, the sorption of iodine decreases with increase in pH above 11·0.

166. Studies on the Bulk Polymerisation of Iso-butyl methacrylate and n-butyl methacrylate.

A. S. NAIR and M. S. MUTHANA, Kharagpur.

In attempts to study the general kinetics of the polymerisation, and solution properties of vinyl normal and iso-esters, polymerisation reactions of isobutyl methacrylate have been completed with benzoyl peroxide and 2,2'-azo-bis-isobutyronitrile. The overall rate of polymerisation follows the square root law with respect to initiator concentration and the rate constant has been found to remain reasonably constant for varying concentration of initiators.

167. Copolymerisation of vinyl iso-caproate with vinyl acetate and ethylene.

M. S. MUTHANA, Kharagpur.

Copolymerisations of vinyl iso-caproate with vinyl acetate and ethylene have been studied, and the reactivity ratios of the monomers in the copolymer reactions computed. The reactivity ratios for the system, vinyl-iso-caproate-vinyl acetate, have been found to be 1·14 and 0·67 respectively. The product r_1r_2 indicates for this system, that the alternation tendency predominates over the occurrence of a sequence of like units.

Ethylene copolymerizes with vinyl iso-caproate in the mole ratio 4 :1 even at pressure of the order of 2,000 psi. whereas ethylene and vinyl acetate under same conditions gives copolymers of approximate composition 1 :3.

168. Electrophoretic studies of mustard seed proteins.

A SEN and N. K. SINHA, Calcutta.

Electrophoretic studies of proteins of mustard seed (*Brassica Compestris*) have been carried out with the aid of the moving boundary method. A 10% NaCl extract from decorticated and defatted seeds was prepared by extracting for 5-6 hours at 25°C. The clear extract obtained after centrifugation and filtration was saturated to 75-80% with ammonium sulphate when the total proteins were precipitated.

The total precipitate on electrophoretic analysis at 20°C indicated two major components over the pH range 4·0 to 11 0 in buffer solutions of ionic strength 0·1. The isoelectric point of the component (A) was found to be 6·1 and that of the other (B) was 9·6. Fractional precipitation with ammonium sulphate at 24-25% and 70% saturation gave two fractions, which were designated as fractions (A) and (B) respectively. The fraction (A) was quite stable and homogeneous over the pH range studied and was the globulin fraction. The fraction (B) was soluble in water. It has a high iso-electric point at pH 9 60 and appeared to be strongly bound to a colouring matter. The electrophoretic patterns of this fraction at 2°C did not show the typical gaussian symmetry and there was considerable sharpening of the ascending and broadening of the descending pattern. It, however, moved as a single peak over the pH range 6-10.

169. Ion exchange capacity of asbestos studied by radiochromatography.

H. J. ARNIKAR, Varanasi.

Results on chromatographic separation of the alkali ions, labelled by their radioisotopes ^{22}Na, ^{42}K, ^{86}Rb, and ^{137}Cs, on washed asbestos paper bear a marked resemblance to those obtaining on cellulose filter paper coated with a cation exchanger (Dowex-50) following the technique of Lederer. The chromatogrammes were analysed by measuring the distribution of the radioactivity along the developed band, the decay period, absorption of the radiation by filters, etc. In the case of Li, however, its *répartition* was studied by a Perkin Elmer flame photometer. The same order of R_F values was obtained both on asbestos paper and on Whatman filter paper No. 1 coated with Dowex-50, the R_F increasing with decreasing atomic mass.

Relative exchange capacities for alkali ions show that asbestos functions as an ion exchanger of feable capacity of the order of 300 microequivalents per gramme. The value for the asbestos paper used was about 10 microequivalents per cm^2 or slightly superior to that of the Dowex-coated paper of Lederer with a value of 4·3 microequivalents/cm^2.

170. Alcoholysis of oils and fats.

S. K. K. JATKAR and MISS M. V. NATEKAR, Poona.

Alcoholysis of a wide variety of oils has been studied with respect to kinetics of the reaction. Comparative study of ethanolysis of cocoanut, groundnut, castor, sesame, olive, safflower, linseed, chaulmoogra and mustard oils, showed that the rate of ethanolysis decreased with increasing unsaturation and the relative activities of the oils decreased in the order cocoanut, castor, olive, groundnut, sesame, safflower, chaulmoogra, linseed and mustard oil.

171. On the structures of Metatorbernite group of Compounds.

D. M. CHACKRABURTTY, Trombay.

The chemical compositions of some of the compounds of metatorbernite group were found as follows : Abernathyite : $K_2(UO_2)_2$ $(AsO_4)_2 8H_2O$; Synthetic Toegerite : $H_2(UO_2)_3$ $(AsO_4)_2 8H_2O$; Synthetic : $Na_2(UO_2)_2$ $(AsO_4)_2 8H_2O$; Synthetic : $(NH_4)_2(UO_2)_2$ $(AsO_4)_2 8H_2O$; Meta Autunite I : $Ca(UO_2)_2(PO_4)_2$ 2·1/2H_2O-6 1/2H_2O.

All these compounds belong to the tetragonal system and excepting the odd orders of hko planes being absent (i e. h+k = even planes present) there is no other systematic absence of hkl planes.

Probable space group and suitable structure for these compounds are discussed and explained.

172. Intermicellar dimensions of some Cellulose fibres by X-ray diffraction methods.

D. M. CHAKRABURTTY, Trombay.

Number of fibres of cellulose type of Indian origin were examined by X-ray Diffraction methods with the idea to find out the dimensions of intermicellar spaces after infiltrating colloidal gold and colloidal silver within the fibre frame works and measuring the particle size of the crystallites by the usual methods. The results showed that most of the fibres of Indian origin have larger dimensions of intermicellar spaces and hence more loosely bound than the ramie variety. Some conclusions were derived from these measurements and were discussed.

173. Differential Thermal analysis of some Uranium-Fluorine Compounds.

C. T. MEHTA and N. S. KRISHNA PRASAD, Trombay.

Differential thermal analysis has been widely used in recent years to study the thermal reactions involving endo- or exothermal processes of many inorganic and organic compounds. Relatively little application of this method has been made to study the behaviour of uranium compounds. A few uranium-fluorine compounds were prepared in a pure state and examined by differential thermal analysis with a view to understand their behaviour in some of the solid-gas reactions in which they are used to obtain uranium tetrafluoride.

174. Fluorescence Spectrum of Uranyl Acetate.

BHUWAN C. PANDEY, Trombay.

The fluorescence spectra of Uranyl Acetate obtained from B.D.H. and of the same after recrystallisation have been investigated at room and liquid nitrogen temperatures.

In the fluorescence spectrum of the B.D.H. salt, a series of bands is observed at room temperature. On cooling the salt to liquid nitrogen temperature, the bands become sharp and shift towards the shorter-wave-length side.

In the fluorescence spectrum of the recrystallised salt at room temperature, an additional series of bands is observed in the longer wave-length side of the usual series ($\triangle y \sim 240$ cm.$^{-1}$). On lowering the temperature of the salt, this additional series increases in intensity.

If the recrystallised salt is heated to 45°C, sealed, and later when its fluorescence spectrum is observed at room and liquid nitrogen temperatures the additional series is found to be absent and a spectrum essentially similar to the acetate B.D.H. is obtained.

175. Preparation of Uranium Tetrafluoride from Crude Sodium Diuranate by photochemical reduction.

T. R. BHAT and N. S. KRISHNA PRASAD, Trombay.

A method of preparation of uranium tetrafluoride from crude sodium diuranate is given. Ammonium uranyl fluoride obtained from sodium diuranate is reduced photochemically to ammonium uranium fluoride which is subsequently decomposed under vacuum to give uranium tetrafluoride. A number of factors influencing the photoreaction, viz., the choice of reducing agent, acid, concentrations of uranium, acids and reducing agents, depth of solution etc. have been investigated. It was found that a combination of alcohol and sulphuric acid were the best for the reduction and for a solution containing 4·8% U, 10% alcohol and 1% H_2SO_4 the effective depth of solution was 7·5″. The yield of ammonium uranium floride under these conditions was 90-95% in 4 hours.

The decomposition of ammonium uranium fluoride and the effect of temperature on the packing density of the uranium tetrafluoride obtained have also been studied.

176. Fuorescence Life-Times of Fluorescein Ion.

(MISS) K. K. ROHATGI, Jadavpur.

The fluorescence life-time, τ, of fluorescein ($C = 1{\cdot}016 \times 10^{-1}M$) in KOH ($C = 1{\cdot}284 \times 10^{-4}M$) was measured from the area under the absorption curve obtained by plotting molar extinction co-efficient ε, against wave number ω cm^{-1}. Five different hydroxylated solvents such as water, series of primary alcohols and glycerol were used. The max was found to decrease with decreasing dielectric constant of the medium, but the osciliator strength, Σf remained practically constant at a value of 0·58.

These life time values were compared with those obtained for the same solution by phase-shift method of Bailey and Rollefson later modified by Gwinn and Kromman using modulated light source. When correction (near 30%) for absorption and re-emission of the fluorescent light (due to considerable overlap of absorption and emission curves) was applied to these values, a large discrepancy between τ values obtained by these two methods was observed.

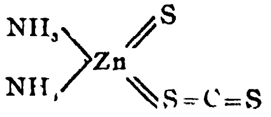
This discrepancy has been discussed in the light of radiationless processes such as internal conversion, solvent and concentration quenching etc., present in the actual system which will affect the population of the excited state thus decreasing the quantum efficiency of fluorescence but will not affect the population of the ground state which will govern the absorption probability.

177. A Crystallographic investigation of the structure of Zinc Thiocarbonate. $ZnCs_3.2NH_3$.

N. R. KUNCHUR, Trombay.

The structure of zinc thiocarbonate can be written either

as



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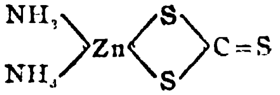

. . . . II

From anology with the structure of the carbonates, it seems that the structure II is likely to be the correct one. The x-ray investigation also favours this assumption. The crystallographic data is as given below :

$a = 9{\cdot}67 \pm {\cdot}03$A°, $b = 11{\cdot}40 \pm {\cdot}05$, $c = 6{\cdot}43 \pm {\cdot}02$A°
$d = 1{\cdot}94$ gm/ccs. $z = 4$ Space group Cmcm or Ama2.

178. The preparation of transparent Thorium Succinate gels.

Y. D. UPADHYA and S. P. MUSHRAN, Allahabad.

The addition of sodium succinate to thorium chloride solution in amounts less than the equivalent value gives a colloidal solution of thorium succinate. The colloidal solution in unstable and precipitation soon occurs. In presence of glucose solutions of suitable concentration the colloidal solution is however suitably stabilised and the precipitation is controlled in a manner that when the sol is left undisturbed it gains viscosity and in the course of time sets to a firm transparent gel. A mixture of 2·0 ml. thorium chloride solution (M/2·39) and 1·4 ml. glucose solution (15%) with 5·4 to 6·0 sodium succinate solution (0·12M) has a gelling time ranging from 145 to 220 minutes at 35±0·1°C. The gel is obtained within a narrow range of the stabilising glucose solution. The pH of the gel forming mixtures range from 2·6 to 4·5 indicating the acid character of the gels.

179. Influence of ultrasonic radiations of the conductivity and gelling time of Zirconium Succinate sols.

Y. D. UPADHYA and S. P. MUSHRAN, Allahabad.

The interaction of sodium succinate and zirconium nitrate solutions of suitable concentrations give stable positively charged sols of zirconium succinate which can be easily purified by dialysis. Sols of sufficient purity yield transparent and stable gels when coagulated with KCl or K_2SO_4 solutions. The gelling time depends upon the concentration and purity of the sol. Exposure of the sol to ultrasonic radiations from a Mullard generator with a barium titanate transducer producing a frequency of 1 mega cycle per second showed that the gelling time of the exposed sol is greater than that of the unexposed one. There is also a marked increase in the conductivity of the sol after exposure. The increase in the gelling time is due to the depolymerising action of the ultrasonic radiation and the increase in conductivity is certainly due to the release of the stabilising ions and the weakening of the adsorptive capacity of the colloid surface.

180. Oxidation of Manganous ions by Acid Dichromate.

B. P. GYANI and S. N. PRASAD, Patna.

The oxidation of ferrous ions by acid dichromate is well known and is a basis for quantitative estimation of ferrous iron. The corresponding oxidation of Manganous ions has not been studied extensively. This reaction and its converse i.e. reduction of manganic to manganous, are of considerable interest, particularly the latter, since it is likely to be an important step in the complete reduction of permanganate in acid media.

Preliminary work showed that in general the reaction is not instantaneous as with ferrous ions. It is therefore decided first to study the equilibrium states. The simplest of doing this is to carry out titrations of $MnSO_4$ in various concentrations of H_2SO_4 with a stronger solution of $K_2Cr_2O_7$. For this purpose stock solution of $MnSO_4$ (N/2 with respect to Mn++) and $K_2Cr_2O_7$ (N/2 with respect to available oxygen) i.e. N/4 w.r.t. Oxygen requirement were prepared. These solutions were diluted suitably when necessary. A stock of pure sulphuric acid was also taken. The titration were carried out with the help of a platinum wire electrode. Other side saturated Calomel, with agar-agar bridge saturated with potassium chloride. The results are shown in the following tables. Only 15-20 minutes were allowed for equilibrium after addition of dichromate.

TABLE 1. Titration of 25 c.c. $MnSO_4$ (N/20 w.r.t. oxygen requirement) with N/2 $K_2Cr_2O_7$ (burette).

Temp. °C	Conc H_2SO_4 in mixture	Dichromate required, c.c.	Remarks
35·8	N/1	2·3	Vague infl.
36·0	2N	2·5	Large infl.
34·8	3N	2·5	Small infl.
36·0	4N	2·5	Vague, small infl.
36·3	6N	2·5	Small, definite infl.
36·2	8N	2 5	Just perciptible infl.

The titration of 25 c.c. N/40 $MnSO_4$ (w.r.t. O required) in 6N H_2SO_4 product a small but very satisfactory inflection at 1 25 c.c. $K_2Cr_2O_7$. The titration was then revised with the following results.

TABLE 2. Titration of 25 c.c. $K_2Cr_2O_7$, N/10 with $MnSO_4$ (N/4 w.r. oxygen required)

Temp. °C	Conc. H_2SO_4 in mixture	$MnSO_4$ req. c.c.	Remarks
36·2	2N	10·2	Satisfactory infl.
36·5	6N	10·7-10·9	Large infl.

The experimental points (EMF against vol. of titrating solution) were often quite erratic. The points in the case of 6N H_2SO_4 (both direct and reverse titrations) were remarkably smooth. It appears therefore that in many cases the time allowed for equilibrium was far from adequate. The results were particularly erratic in the titration of 25 c.c. N/40 $MnSO_4$ (2N H_2SO_4) with N/2 dichromate.

If two Mn++ ions require 1 atom of oxygen, one should expect the inflection at 2·5 c.c. in Table 1 and 10 c.c. in Table 2. The slightly larger value in Table 2 shows that the reaction may be faster in presence of excess $MnSO_4$, and the larger value of Table 2 are due to delayed equilibrium. However, it appears to be substantially established that the net reaction in these titration is

$$2MnSO_4+H_2SO_4+O=Mn_2(SO_4)_3+H_2O$$

and there are no side reactions consuming the oxygen.

181. Decomposition of organic Halogen compounds by Ultrasonic waves—Part—V. Decomposition of Ethylene Bromide.

SATISH CHANDRA SRIVASTAVA, Calcutta.

Decomposition of ethylene bromide in aqueous solutions by ultrasonic waves of 1—2 MC/S has been studied. As in the case of other halides studied, a brown coloured solid was produced and bromine both in ionic and molecular state was evolved. The liberation of bromine has been found to be of zero order and the rate of the reaction is faster at lower temperatures, as well as at the lower of the two frequencies studied. Pure ethylene bromide failed to decompose in presence of ultrasonic waves.

182. Decomposition of organic Halogen compound by Ultrasonic waves—Part—IV. Decomposition of Ethylene Dichloride.

SATISH CHANDRA SRIVASTAVA, Calcutta.

Aqueous solutions of ethylene dichloride have been found to decompose under the influence of ultrasonic waves producing chlorine both in ionic and molecular state and yellowish solid, probably a polymerised substance. Effect of ultrasonic intensity, bulk of the liquid and dilution effect have been studied. The kinetics of the reaction has been found to be of zero order at both the frequencies (2100 KC/S and 990KC/S) studied but rate of the reaction is faster at lower frequency. The reaction proceeds faster at lower temperatures. Organic liquids such as alcohol or acetone retard the reaction.

183. Studies on the Composition and Properties of some less familiar metal Ferrocyanogen-Complexes—Part II Chromous Ferrocyanide.

K. M. ABUBACKER and WAHID U. MALIK, Aligarh.

Although Cr (iii) does not give precipitate with K_4FeCy_6 at the ordinary temperature, Cr (ii) gives precipitates, ranging from dirty yellow to dirty green with this reagent. Precipitation was carried out under the following conditions : (i) $CrCl_2$ added to excess of K_4FeCy_6; (ii) K_4FeCy_6 added to excess of $CrCl_2$ and (iii) mixing the reactants as to give a precipitate, containing neither of the reactants in excess. The dried precipitate gave one mole of bound water*per mole of the complex. The formulae were $K_2CrFeCy_6$; Cr_2FeCy_6 and $K_2Cr_3(FeCy_6)_2$ respectively.

Conductometric and potentiometric titrations (direct and reverse) between $CrCl_2$ and K_4FeCy_6 of different concentrations and in aqueous and aqueous-alcoholic medium confirm the results of analysis The composition was found to be $K_2CrFeCy_6$ and

Cr_2FeCy_6. Titre values point towards the adsorption capacities of the precipitates. Both direct and reverse amperometric titrations, applying a potential of −0·2 volt, were carried out. Only one break pointing for the formation of Cr_2FeCy_6 could be obtained. Unlike Cr+++, discrepancies in the aqueous medium could be accounted for using aqueous-alcoholic medium.

Quantitative studies on the adsorption give evidence for the formation of the complex $K_2CrFeCy_6$; K_4FeCy_6. Chromous was adsorbed to a much lesser extent—0·3 and 0·1 mole per mole in the two media (aqueous and alcoholic Hydrolysis was negligible at ordinary temperature but at 55° and at larger dilution, it was quite appreciable (1·8%).

184. Studies on the Electrometric behaviour of Chromous Ions—Part IV—Reduction of different varieties of Chronic Chloride at the Dropping Mercury Electrode and the Anodic Waves of Cr. (ii).

K. M. ABUBACKER and WAHID U. MALIK, Aligarh.

Four samples, freshly prepared and aged solutions of green hydrate, violet solution and Cr(iii) from chromous chloride, were reduced at the dropping mercury electrode using different concentrations of the supporting electrolyte (KCl). Two stages of reduction were observed, the E/2 value for the second wave was the same for all samples, being independent of either the concentration of Cr(iii) or KCl The E/2 avlues for the different samples were : (i) 1·1 volts for Cr(iii) obtained from Cr(ii); (ii) 0·8 volt for the freshly prepared green hydrate; (iii) 0·95 volt for the aged green variety and (iv) 1·0 volt for the violet. It appears that the violet variety is the most stable and that Cr(iii) as obtained by oxidation of Cr(ii) gives high value due to the formation of $CrCl_2$. 0 $CrCl_2$.

Anodic waves of Cr(ii) obtained by the reduction of green hydrate by Zn and HCl were studied in presence of acids (HCl, H_2SO_4, HAC) and their salts and complexing agents like oxalate, tortrate, citrate etc. (used as supporting electrolytes). Variations in Cr(iii)/Cr(ii) did not influence either the anodic or cathodic half wave potentials. Different supporting electrolytes influencned the anodic potentials to different extents. Oxidation could not be observed in presence of citrate, tartrate and oxalate. From the observations it was concluded that the presence of H or Cl ions or both are essential for purposeful utilisation of $CrCl_2$ as a reducing agent. Interesting behaviour was shown by NH_4^+ ions.

185. Studies on heavy metal soaps—Part I. Conductometric and Aperometric studies of the Interaction of Cobalt Chloride and Copper Sulphate with Sodium Myristate.

A. AZIZ KHAN and WAHID U MALIK, Aligarh.

For conductometry, the concentrations of cobalt chloride and copper sulphate were varied from 0·1 M to 0·02 M while three different concentrations of sodium myristate viz.. 0·01 M, 0·006 M and 0·003 M were employed for titrations. It was observed that soap solution at 0·003 M behaves as a strong electrolyte. The ratios of interaction, in this case are 1 :2 for cobalt chloride. The compounds corresponding to these ratios may be represented as $CuMy_2$ and $CoNaMy_3.CoCl_2$. Discrepencies were observed on using soap solutions of higher concentration. When the concentration reached 0·01 M marked varaitions from the behaviour as shown by ·003 M solutions were observed.

Amperometric titrations were carried out between sodium myristate against cobalt chloride and copper sulphate using 0·1 M potassium chloride as the supporting electrolyte. Current-volume curves gave typical amperometric curves, when the metal ion was added from the burette to the soap solution in the cell. Reverse titrations, however, gave unsatisfactory results. Ratios of interaction, in these cases, were 1 :2 for copper sulphate and 1 :3 for cobalt chloride.

186. Studies on the Electrochemical behaviour of Chromous Ions—Part III. Factors Influencung the Redox Potential of Chromous-Chromic system.

K. M. ABUBACKER and WAHID U. MALIK, Aligarh.

Extensive work has been carried out on the redox potential of Cr(ii) solution obtained by the reduction of Cr(iii) by Zn and HCl. The redox potential (measured for a definite Cr(iii)/Cr(ii) ratio) was found to be influenced by the electrode material (Hg and Pt), presence of acids and neutral salts and under controlled pH. On diluting the solution the measured potential was also affected. Then interesting observations have been explained in the light of (i) Sensitivity of mercury surface towards Cl^- and SO_4^{--} and preferential adsorption, (ii) complex ion formation with the anion of the acid and its salts (from curves between pH and E and p Cl^- and p SO_4^{--} and E) and (iii) the hydrolytic character of the solution. Another interesting feature is the abnormal variation E on the addition of freshly prepared chromic salt to the chromous solution.

187. Study of Electrical Conductance of Cationic Soap Solutions.

(MISS) L. V. ASOLKAR and BYOMKESH BISWAS, Calcutta.

The electrical conductance of an aqueous soap solution is greatly influenced by micelle formation. Winsor's theory of solution which describes the solubilisation process as a gradual shift of equilibrium amongst various micellar forms spherical and lameller, anticipates a discontinuous change of conductance in the course of solubilisation involving liquid crystalline phase. The paper presents data on variation of electrical conductance in the course of solubilisation of water in the following systeds :—(1) $C_{12}Me_2\,BuNBr+C_6H_5Cl$ at 30°, (2) $C_{12}PyCl+CHCl_3$ at 30° and (3) $C_{12}Me_2Et.\,N\,Br+CHCl_3$ (70% $+CCl_4$ (30%).

Interesting observation is made in the variation of conductance in the G region, where a slight maximum is obtained. This, however, cannot be explained by Winsor's theory. It is likely that the G phase passes through various stages of directional orientation thus giving maximum conductance corresponding to maximum anisotropy in the G region.

188. Chromatographic study of Anionic Complexes : Part III. Metal Citrate Complexes.

ERIC JOHN SINGH and ARUN K. DEY, Allahabad.

In this paper the variation of diffusion through filter paper strips by the ascending method, of citrate complexes of Cu (II) Ni (II), Co (II) and Fe (III) has been studied, using 50%, 55% 60% ethanol as solvents. The Rf value is found to be less with higher concentrations of ethanol used. It has been noted that with 50% ethanol, the Rf values increases with the addition of citrate and finally tend to become constant as the citrate is increased. In 50% ethanol the values attain constancy with a higher proportion of citrate added. In 60% ethanol the Rf values are unaffected by small amounts of the complexing agent, but on increasing its concentration the Rf values begin to diminish.

189. Chromatographic study of Anionic Complexes : Part II. Metal Tartrate Complexes.

ERIC JOHN SINGH and ARUN K. DEY, Allahabad.

The diffusion of tartrate complexes of Cu (II), Co (II), N (II) and Cd (II) through filter paper strips has been examined using 50% and 60% ethanol as solvents. The Rf values are higher when 50% ethanol is employed. In the cases of Cu (II), Co. (II) and N (II) with 50% ethanol, it is noted that the Rf values decrease with the addition of tartrate in the beginning. Then the value increases and finally becomes constant. In the case of Cd (II) the Rf value decreases by the addition of the complexing agent. In 60% ethanol the Rf values do not change by small additions of tartrate but decreases with higher concentrations of the tartrate. In case of Cd (II) the Rf value tends to zero with increasing concentrations of tartrate.

190. Chromatographic study of some Oxalate Complexes.

ERIC JOHN SINGH and ARUN K. DEY, Allahabad.

In this paper oxalate complexes of Ni (II), Co (II), Fe (II) and Fe (III) have been studied using ascending filter paper strip method with 50 per cent ethanol as solvent. It has been noted in the case of Ni (II), Co (II) and Fe (II), that the Rf value decreases by the addition of oxalate and finally reaches nearly to zero and then suddenly increases as complete redissolution of the precipitate occurs. Finally the values have a slight tendency to diminish again.

It has been noted in the case of Fe (III) that the Rf value does not change by small additions of oxalate. As the concentration of oxalate is increased, the value begins to increase to a maximum and then has a slight tendency to diminish.

191. Effect of Structure on the Rates of Oxidation of Monohydric Alcohols and Aliphatic Aldehydes by Chromic Acid.

A. C. CHATTERJI and VARKEY ANTONY, Lucknow.

A general study of the temperature coefficients of the oxidations of n-propyl alcohol, iso-propyl alcohol, n-butyl alcohol, sec-butyl alcohol, iso-butyl alcohol, and sec-hexyl alcohol and acetaldehyde, n-butyraldehyde and iso-butyraldehyde by chromic acid in presence of perchloric acid allowed the calculation of relative thermodynamic quantities (energies, entropies and free energies of activation) relative to those of iso-propyl alcohol. The following equations have been used :

$$\Delta G^* - \Delta G_0^* = -RT \ln k/k_0$$

$$\Delta S^* - \Delta S_0^* = \frac{\delta}{\delta T} (RT \ln k/k_0)$$

$$\Delta H^* - \Delta H_0^* = RT^2 \frac{\delta}{\delta T} (\ln k/k_0)$$

The reaction rates increases with the increase in the molecular weight. The methyl group has a general effect of decreasing the energy of activation. The entropy of activation values indicate that the rigidity of the compounds is probably in the order : iso-propyl- > sec-butyl- > sec-hexyl- > n-butyl- > iso-butyl- > n-propyl-alcohol; iso-butyraldehyde> acetaldehyde > n-butyraldehyde. The free energies of activation show a very good parallelism with the rates of oxidation.

192. The application of Differential Thermal Analysis to the study of solid catalysts : system ZnO-Fe_2O_3.

G. SRINIVASAN and S. K. BHATTACHARYYA, Kharagpur.

Intimate mixtures of the zinc oxide and ferric oxide in equimolar proportions, prepared by different methods, were subjected to differential thermal-analysis. All the samples exhibited an exothermic effect in the temperature range 675—800°C. due to the formation of the spinel zinc ferrite. In case the exothermal effect commenced at about 675°. Just below this temperature, $ZndO$-Fe_2O_3 mixture was found to exhibit maximum catalytic activity for the conversion of alcohol to acetone. Above 675°, the formation of the spinel took place which resulted in a loss of catalytic and adsorptive activity. The results are in accordance with those of x-ray diffraction, magnetic susceptibility and catalytic activity tests.

The coprecipitated ZnO-Fe_2O_3 mixture exhibited a stepwise exothermal peak at higher temperatures, representing perhaps the stepwise spinel formation.

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193. Determination of the Structure of Gum Geol.

A. K. BHATTACHARYYA, D. CHOUDHURY and P. BAGCHI, Calcutta.

The gum was investigated by Mukherjee and Banerjee who, however, worked with a sample which was precipitated as a resinous mass having a high ash content. We have been able to obtain the gum in the form of a fine white powder having properties mentioned below which did not change on further purification.

$[\alpha]^{31.5}_{D} = 28{\cdot}7^\circ$; Moisture 4·43; Ash 0·94, equivalent weight (by potentiometric titration) 1200; pentosan 28% and uronic anhydride 14 5% (calculated for gum of equivalent weight 1200—14·7%). Hydrolysis of the gum with acid led to the formation of galactose and arabinose identified by paper chromatography as well as formation of derivatives and a biuronic acid whose detailed structure is under investigation. No methyl pentose could be detected inspite of special efforts in this direction.

194. Antispasmodic Compounds.

B. SAHOO, P. B. TRIPATHY and M. K. ROUT, Orissa.

In the present investigation, some quinolyl thiazoles, quinolyl thiazolidines and quinolyl iminazolidines have been prepared for study of their antispasmodic action and formulation, if possible, of any general relationship between antispasmodic action and variation of the heterocyclic nucleus as well as changing substitution on the heterocyclic nucleus. They were prepared by two methods (i) by reduction with Zn & acetic acid of the corresponding o-nitro-benzylidene compounds (ii) by fusion with anthranilic acid. The spasmolytic tests were carried out in the Medical College, Orissa. Almost all the drugs possess to some extent musculotropic activity.

195. Partial Dehydrogenation of Steroids with Raney Nickel.

R. N. CHAKRAVARTI, (MRS.) D. CHAKRAVARTI and M. N. MITRA, Calcutta.

In view of the importance of Raney nickel as a dehydrogenating catalyst it was found desirable to study the effect of Raney nickel on diosgenin following the methods of Chakravarti and Robinson (J. Chem. Soc., 1947, 78) for the conversion of strychnine into neostrychnine.

For this purpose, diosgenin was heated under reflux in xylene solution in presence of Raney nickel catalyst. On working up, however, major portion of the diosgenin was recovered unchanged. The reaction was then repeated at a higher temperature using *p*-cymene as a solvent instead of xylene. The refluxing was carried out in an atmosphere of dry nitrogen. The product obtained in this case was found to be mainly Δ^4-diosgenone. The product was identified by determination of its melting point, rotation and mixed melting point with a sample of diosgenone prepared by chromic acid oxidation of diosgenin, and also by analysis.

It was also observed that when cholesterol was similarly heated under reflux with Raney nickel in *p*-cymene solution, Δ^4-cholestenone was the main product. It may be mentioned in this connection that Romo (Bol.inst.quim.univ.nacl.auton., 1952, *4*, 91) reported the formation of 3-oxoΔ^4-steroids by the oxidation of 3-hydroxyΔ^4-steroids with Raney nickel in the presence of acetone or methyl ethyl ketone as hydrogen acceptor, but no reaction occurring with isolated hydroxyl compounds or with 3-hydroxyΔ^5-steroids. According to Kleideren and Kornfold (J. Org. Chem., 1948, 13, 455), however, cholesterol is converted to Δ^4-cholestenone when cholesterol is heated in toluene solution in presence of cyclohexanone as hydrogen acceptor.

196. Constitution of Clerodin.

AJIT K. BANERJEE and P. K. BOSE, Calcutta.

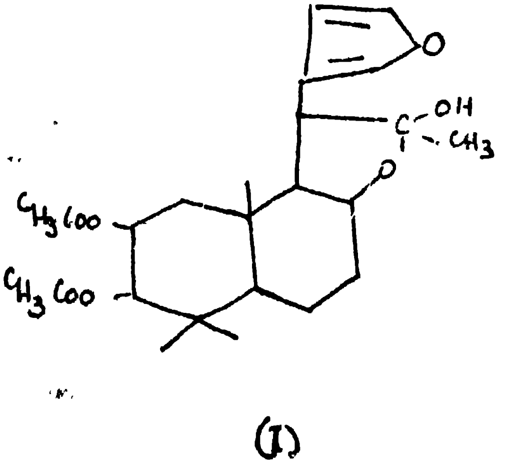
Clerodin is the crystalline bitter principle of *Clerodendrum infortunatum* Linn. previously investigated by Banerjee (J. Ind. Chem. Soc., *14*, 15, 1937) and Chaudhury and Dutta (ibid, *28*, 295, 1951). The analytical values of clerodin strongly suggested the alternative molecular formula $C_{21}H_{34}O_7$, which has been corroborated by X-ray analysis.

The presence of two acetoxy groups one *β*-substituted furan ring and a hemiketal system in clerodin has been demonstrated both by chemical as well as by physical methods, thus accounting for all the seven oxygen atoms of clerodin.

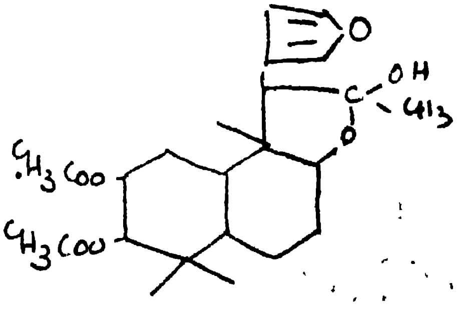
The degradation of clerodin to 1 :2 :5-trimethylnaphthalene pointed out that it belongs to the group of diterpenoid bitter principles, closely allied to marrubiin and columbin.

Several exploratory experiments were performed to settle the relative positions of the functional groups.

On the basis of our observations clerodin could be represented as (1) or (2).



(1)



(2)

197. The Constitution of Albigenic Acid—a new Triterpenoid Sapogenin from Albizzia lebbeck Benth.

A. K. BARUA and S. PATTABI RAMAN, Calcutta.

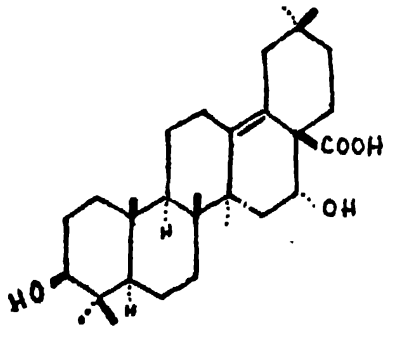
In an earlier communication (A. K. Barua and S. P. Raman, Science & Culture, *23*, 435-36, 1958) the isolation of echinocystic acid and albigenic acid, a new triterpenoid sapogenin, from *A. lebbeck* Benth was reported. Albigenic acid, $C_{30}H_{48}O_4$, m.p. 246-48°; $[\alpha]^{35°}_{D}$ $-12{\cdot}0\pm0{\cdot}5$ (ethanol), gave a monomethyl ester, $C_{31}H_{50}O_4$, m.p. 225-26°; $[\alpha]^{27°}_{D}$ $-9{\cdot}5\pm1$ (ethanol), which formed a diacetate, $C_{35}H_{54}O_6$, m.p. 189-90°; $[\alpha]^{27.5°}_{D}$ $-53\pm0{\cdot}5$ (chloroform).

Albigenic acid gave a pale yellow colouration with tetranitromethane showing the presence of unsaturation. Methyl albigenate consumed one mole of perbenzoic acid within 24 hours indicating the presence of one double bond. It, however, resisted hydrogenation over Adam's catalyst under standard conditions and was not attacked with osmium tetroxide.

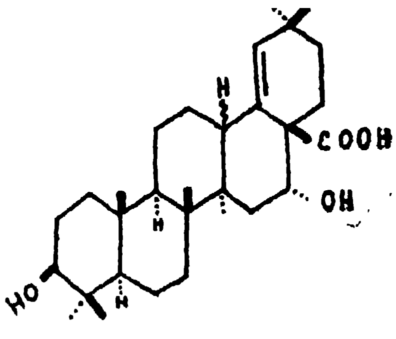
Under comparable conditions the rate of alkaline hydrolysis of methyl albigenate was found to be the same as that of methyl echinocystate. Methyl albigenate on oxidation by the Sarett's method furnished a diketoester, $C_{31}H_{46}O_4$, m.p. 207-9°, which suffered decarboxylation on alkaline hydrolysis indicating the presence of a keto group β- to the carboxyl group. Diketomethyl albigenate gave a positive Zimmermann colour reaction showing the presence of a 3-keto group. That the ethylenic double bond in albigenic acid is in the $\beta\gamma$-position to the carboxyl group is shown by the fact that the acid undergoes ready thermal decarboxylation at its melting point.

Albigenic acid, unlike oleanolic acid, did not form a bromolactone under conditions those used for oleanolic acid. However, with HBr in acetic acid it formed a lactone diacetate, $C_{34}H_{52}O_6$, m.p. 280-81°, which was found to be identical with the 18-*iso*echinocystic lactone diacetate, prepared from echinocystic acid under the same conditions.

The above observations clearly show albigenic acid to be a pentacyclic triterpene of the oleanane series closely related to echinocystic acid and can be represented either as (I) or (II).



(I)



(II)

198. Saponin and Sapogenin, Part II—The constitution of Proceranin, a new Saponin from Albizzia Procera Benth.

M. O. FAROOQ, I. P. VARSHNEY, W. RAHMAN and HAMEEDUL HASAN,
Aligarh.

A new Saponin, proceranin m.p. 156-58° isolated from Albizzia procera Benth., as a colourless powder, has been shown to be tetra-glycoside of Δ^{12}, 3β, 21β, dihydroxy-18-β-oleanene 28-oic acid with approximately equal molecular ratio of d-glucose, d-arabinose, d-xylose and l-rahmnose as sugar mioties.

199. Search for new Antimalarials : Synthesis of some substituted 1:2-Dihydro-1:3:5-triazines—Part II.

A. B. SEN and P. R. SINGH, Lucknow.

In continuation of our work on the above subject, twenty-five new 1 :2-dihydrotriazine derivatives have been prepared from different substituted anilines, dicyandiamide and diacetonealcohol or mesityloxide with a view to study the effect of hydroxy and unsaturated groupings on the antimalarial activity. The dihydrotriazines were characterised through their picrates, nitrites and bicarbonates and their structures confirmed by their ultraviolet absorption spectra ($\lambda^{H_2O}_{max.}$ 241 mμ). The compounds are being tested at the Malaria Institute of India, Delhi, for their antimalarial activity.

200. Search for new Antimalarials : Synthesis of Some New 1:2-Dihydro-1:3:5-triazines—Part I.

A. B. SEN and P. R. SINGH, Lucknow.

In view of the high antimalarial activity of the paludrine-metabolite, 4 :'-diamino-1-(p-chlorophenyl)-2 :2-dimethyl-1 :2-dihydro-1 :3 :5-triazine, twentyfive 1 :2-dihydro-1 :3 :5-triazine derivatives have been synthesised by "The Three Component" and "The two Component" syntheses of Modest *et al.* (*J. Org. Chem.*, 1956, *21*, 1; *ibid*, 1956, *21*, 14), with a view to find out their antimalarial activity.

The dihydrotriazines were characterised through their picrates, nitrites and bicarbonates. They were distinguished from the corresponding biguanides by their non-formation of a coloured complex with cuprammonium-sulphate and their structures confirmed by means of their characteristic ultraviolet absorption spectra ($\lambda^{H_2O}_{max.}$ 241-242 mμ).

The antimalarial activities of the dihydrotriazines prepared are under investigation at the Malaria Institute of India, Delhi.

201. 2-Alkyl-3-p-substituted sulphonamidophenyl-6-halo-4(3)-quinazolones as potential antimalarials.

H. L. BHAMI and M. S. DHATT, Delhi.

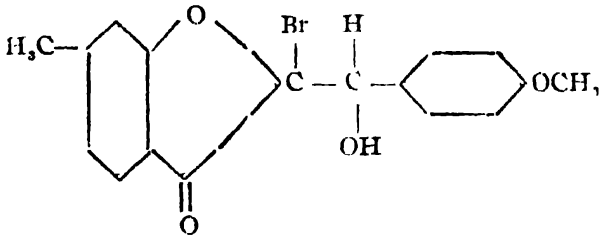
Several 2-methyl-3-aryl-4(3) quinazolones have shown some promise as antimalarials (Coatney *et al*, *J. Nat. Malar, Soc.*, 1950, *9*, 183; Jain and Narang, *Res. Bull. East Panjab Univ.*, 1953, *29*, 51; Bami and Dhatt, *J. Sci. & Indr. Res.*, 1957, *16B*, 558). Similarly a number of 2 (or 4) sulphanilamido-quinazolines have also been reported to be active, (Wolf, U.S.P. 247, 3931, 1949). Consequently as an extension of our previous work, several 2-alkyl-3-*p*-substituted sulphonamidophenyl-6-halo (or H)-4(3)-quinazolones have been synthesised as potential antimalarials. For their synthesis appropriate benzoxazones were reacted with sulphadiazine, sulphamezathine, sulphapyridine, sulphaguanide and sulphathiazole by fusion at 160-180°C under vacuum. The products were obtained in 60-70 per cent yield and crystallized from dilute acetic acid as colourless to yellow crystals. The following derivatives are described :

(i) 2-Methyl-3-*p*-(4′ : 6′-methyl-2′-pyrimidyl) sulphonamidophenyl 4(3) quinazolone, m.p. 272°C. (ii) 2-Methyl-3-*p*-(2′-pyrimidyl)-sulphonamidophenyl-4(3) quinazolone, m.p. 275°C. (iii) 2-Methyl-3-*p*-(2′-pyridyl) sulphonamidophenyl-6-chloro-4(3)-quinazolone, m.p. 243°C. (iv) 2-Ethyl-3-*p*-(2′-thiazolyl)-sulphonamidophenyl-6-chloro-4(3)-quinazolone, m.p. 286°C (shrinks at 275°C). (v) 2-Methyl-3-*p*-guanidino-sulphonyl-phenyl-6-bromo-4(3)-quinazolone, m.p. 304°C. (vi) 2-Methyl-3-*p*-(2′-thiazolyl)-sulphonamidophenyl-6-bromo-4(3)- quinazolone, m.p. 268°C.

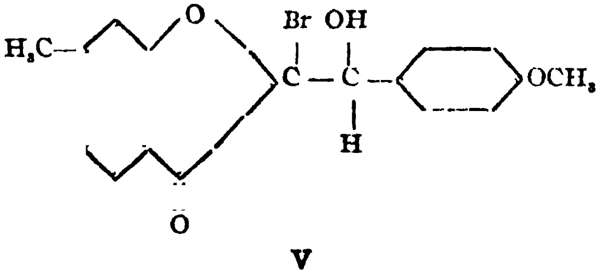
202. Oxidative Ring expansion of 2-benzylidene Coumaran-3-ones.

M. G. MARATHEY, Amravati.

6. Methyl-2-anisylcdene coumaran -3-one, I, was found to undergo oxidative ring expansion with Na_2O_2 to give 4′-methoxy-7-methyl flavonol, II. On treatment with bromine in acetic acid I gave its dibromo derivative, m.p. 180°, III which when refluxed with aqueous acetone gave two isomeric α-bromo-β-hydroxy derivatives, IV and V of I. IV, which gave the flavonol, II, with alkali has been tentatively assigned the structure where Br and OH are trans to each other while in V they are cis. V gave the isomeric 2-anisoyl coumaran-3-one with alkali.



IV



V

203. Possible antiamoebic agents—Part IX. Synthesis of Mannich bases of Substituted allyl phenols.

A. B. SEN and O. P. MADAN, Lucknow.

The present paper reports the preparation of eleven Mannich bases, from 2-allyl-4 tert-amyl, 2-allyl-6-methyl, and 2-allyl-6-chloro phenols, with a view to test them as antiamoebic agents. These compounds are based on the partial structure of Camoform, an effective amoebicide manufactured by Parke Davis & Co. Sen and Arora (J.I.C.S., August, 1958 issue) have already reported the synthesis of a number of compounds of this type and a few of them have been found to possess antiamoebic activity more than Camoform when tested in vitro.

204. Possible Antiamoebic Agents—Part VIII. Synthesis of Dialkyl-amino-Dimethylene-Phenylethylamines.

A. B. SEN and S. L. ARORA, Lucknow.

In continuation of our work on "Possible anti-amoebic agents", several new dialkoxy—(viz., 3-methoxy-4-n-butoxy; 3-methoxy-4-n-amyloxy; 3-methoxy-4-n-hexyloxy and 3-methoxy-4-n-heptyloxy) phenylethylamines have been prepared from vanillin. These were then converted into dialkyl-amino-dimethylene-phenylethylamines with a view to test them for their amoebicidal activity against *E. histolytica.*

Dialkoxy (3 :4-dimethoxy; 3-methoxy-4-butoxy; 3-methoxy-4-amyloxy; 3-methoxy-4-hexyloxy and 3-methoxy-4-heptyloxy) benzaldehydes were prepared from vanillin and different alkyl halides, which were then converted into the corresponding cinnamic acids by condensation with malonic acid in the presence of pyridine. The cinnomic acids were then reduced by a sodium-amalgam and water into the corresponding dihydro-cinnamic acids which in turn were changed into amides through the acid chloride followed by treatment with aqueous ammonia. The amides were subsequently converted into the corresponding dialkoxy-phenylethylamines by Hocmann's reaction.

205. Composition of some varieties of Tobacco—Part I.

K. A. PATEL, K. A. THAKER and B. N. MANKAD, Vallabhvidyanagar.

It is proposed to work on the leaves, stalks and roots of different varieties of Tobacco for their chemical investigation and utilisation. From the different analytical results obtained, it is observed that the nicotine content in different varieties is as under.

K_{20} 〉 Sokhada 〉 G_6 〉 K_{49} 〉 S_{20} 〉Raskelin

The polarimetric study of the alkaloidel contents of the different parts of tobacco plant is under investigation. Further work evolving a cheap method of oxidation of nicotine to nicotinic acid, is in progress.

206. A note on the preparation of Acid Hydrazides.

S. RAYMAHASAY, S. L. LASKAR and S. L. MUKHERJEE, Calcutta.

Hydrazides are well known in the literature for their various useful properties. Lately wide spread interest has been created by the introduction of Isonicotinic acid hydrazide (Edward H. Robitzek et al., Am. Rev. Tuberc., *65,* 402, 1952) and Cyanacetic hydrazide (Valdecasas et al., Med. Clinica. Barcelona, 1952, *19,* 275) in medicine as powerful antitubercular compounds. The usual methods of preparing hydrazides were by the interaction of acid ester or acid chloride or anhydride with hydrazine hydrate. However Curtius et al (Ber., *35,* 3240, 1920) prepared hydrazides by the more drastic method of fusing the hydrazine salts of acids, which usually gave rise predominantly to secondary hydrazides. Lately a process has been developed in our laboratory where Isonicotinic acid hydrazide has been prepared in good yield by the interaction of Isonicotinic acid and hydrazine hydrate in the presence of a solvent and a diluent. (Sudhir Lal Mukherjee and Albert David, Indian, Patent Specification No. 59350). The purpose of our present investigation is to study and to extend the scope of the patended process for the preparation of some alkyl, aryl and heterocyclic acid hydrazides. With this idea, the hydrazides of the following compounds namely, acetic, propionic, isobutyric, n-vâleric, phenyl-acetic, Benzoic, p-hydroxy Benzoic, Nicotinic, 2-phenyl cinchoninic acid, were prepared and in all cases the yields of the mono hydrazide were found to be good.

207. Composition of the Seed-oil of Ocimum Canum Sims.

C. R. MEHTA, Ahmedabad.

Seeds of Ocimum canum Sims. (N. O. Labiatae) on extraction with petroleum ether gave a yellow fixed oil (yield 8·5%) which has the following analytical constants: *Sp. Gr. at* 30° 0·9206; *Refractive index at* 40° 1·4707, *Acid* Value 72·15; *Saponification Value* 194·5; *Iodine Value* (Hanus) 179·8; *Unsaponifiable Matter* 1·25%; *Hehner Number* 88·14; *R. M. Value* 0·6; *Polenske Value* 0·3; *Acetyl Value* 32·1.

The liquid acids (89·8%) consisted of Oleic acid (50·1%) and linolenic acid (39·6%) while the solid ones (10·2%) were palmitic acid (2·9%), stearic acid (5·7%) and an acid or acids higher than stearic acid (1·4%).

A sterol (m.p. 135-36°) isolated from the unsaponifiable matter has been identified by preparation of its derivatives, colour reactions, etc., as Sitosterol.

208. Synthetic approaches towards Bicyclic Intermediates of some Terpenoids.

SOUMENDRA LAL MUKHERJEE and PHANINDRA CHANDRA DUTTA,
Calcutta.

F. Sondheimer (J. Amer. Chem. Soc., 80, 1958, 1967) reported the synthesis of DL-1,1,6 α, 10 β-Tetramethyl-trans-decal-2-ol-5-one in an effort to complete the total synthesis of triterpenoids. The synthesis of 5,9-dimethyl-$\Delta^{5,10}$-octalin-1-one is being described which is expected to be an important intermediate.

1-methyl-2-carbethoxy-cyclohex-3,5-dione was prepared from Michael addition of ethyl acetoacetate to ethyl crotonate and subsequent ring closure *in situ*. This on enolisation of catalytic hydrogenation of the corresponding enol-chloride (b.p. 127-130°/7·8 m.m.) leads to the formation of 1-methyl-2-carbethoxy cyclohex-3-one (b.p. 113-114°/10 m.m.). This was condensed with ethyl γ-bromo-butyrate to 1-methyl-2-carbethoxy-2-(γ-butyric ethyl ester)-cyclohex-3-one (b.p. 127-130°/0·6 m.m.). Due to the poor yield, this method of approach appeared to be unsatisfactory.

In another approach, Haegemann's ester was condensed with ethyl-γ-iodobutyrate to 3-methyl-4-carbethoxy-2-(γ-carbethoxy propyl)-Δ^{2}-cyclohex-1-one (b.p. 180-185°/4·5 m.m.). On hydrolysis, decarboxylation, esterification (D.N.P.H.—m.p. 119°) and catalytic hydrogenation, leads to 3-methyl-2-(γ-carbethoxy propyl)-cyclohex-1-one (b.p. 140°/3·5 m.m.). On Grignard reaction with magnesium methyl iodide, dehydration and hydrolysis it affords 1,3-dimethyl-2-(γ-carboxypropyl)-cyclohexl-1-one (b.p. 135-137α/0·6 m.m.). This one ring closure furnished two products; one was characterised as 5,10-dimethyl-$\Delta^{5,9}$-octalin-1-one (Semicarbazone, m.p. 190° and the other was the corresponding spiro-cyclopentanone, the presence of which was revealed in the Infra-red through the presence of a cyclopentanone ring.

209. Studies in the directed inter-esterification of conjugated glycerides.

S. K. RAY, N. SEN, M. K. CHAKRABARTY and M. M. CHAKRABARTY,
Calcutta.

The method of directed inter-esterification has been successfully utilised in the field of plastic shortenings but no work seems to have been reported on the utilization of this method in glycerides containing conjugated acids. In the present work some investigations have been made on the maintenance of directed inter-esterification conditions, applying the method of Eckey on the refined seed fat of M. charantia (var. muricata) and Aleurites montana (tang) containing c.a. 47% and 66% respectively of triene conjugated acids (α-elaeostearic). The effect of two catalysts sodium methoxide and calcium naphthanate were studied in relation to (i) time of reaction and (ii) concentration of catalyst. The component fatty acids were determined before and after the experiments by spectrophotometry. The results show that in the case of momordica oil, the yield of solid fraction increases progressively with the time of reaction but the composition of solid fraction varies according to the length of time. The same tendency was manifested by tung oil. Effect of varying concentration of catalyst between 0·05 to 0·2 was found to be negligible.

210. Optical Resolution of Benzylethylmethyl Methanol ($C_6H_5CH_2.C(OH).CH_3.C_2H_5$) via. its hydrogen phthalate.

KUMAR THAKER and N. S. DAVE, Vallabhvidyanagar.

At the time of investigations of tertiary alcohols[1-4] ([1]Hickman & Kenyon, J.C.S., 1955, 2051; [2]Davies, Kenyon & Thaker, ibid, 1956, 3396; [3]Davies, Kenyon & Salame, ibid, 1957, 3358; [4]Danies, Kenyon & Thaker, ibid, 1957, 3151) it appeared that optical resolution of tertiary alcohols might be difficult, for example, the resolution of 2 :4-dimethyl hexan-4-ol and 2-phenyl butan-2-ol approached completion after 15 crystallisations of the brucine salt of the hydrogen phthalate.

Attempts are therefore made to resolve some more tertiary alcohols. The resolution of benzyl-ethylmethyl methanol was taken with this view. The interaction of ethylmethyl ketone on Griguard Complex prepared from benzyl chloride and magnesium gave the carbinol in 61% yield. The carbinol was made to combine with phthalic anhydride in presence of triethylamine at 90-92°C gave benzylethylmethyl hydrogen phthalate in 65% yield. A solution of equimolecular mixture of brucine and the H.P. in ethyl acetate readily deposited the brucine salt, when a sample of the brucine salt after three recrystallisations and decomposition in the usual manners gave (+)-benzylethylmethyl methanol.

211. Studies in the condensation of ethyl acetoacetate with aromatic amines. Part I.

C. R. TALPADE and L. H. GADGIL, Bombay.

The kinetics of the condensation of ethyl aceto-acetate with aromatic amines were studied.

The reaction is of the second order and is retarded by the presence of water or alcohol. High purity of the solvents and the reactants is necessary to carry out the reaction. Impurities in the reaction mixture cause side reactions. The temperature most favourable for the reatcion is between 90° and 120°.

212. Studies in the Condensation of ethyl acetoacetate with aromatic amines. Part II.

C. R. TALPADE and L. H. GADGIL, Bombay.

The reaction was studied at various temperatures and different solvents. From the values of k, the other parameters such as the probability factor* (P) and the energy of activation were calculated.

It is found that Xylene is the best solvent when the probability factors are considered.

The Hammet Equation correlating the dielectric constant of the reactants with the reaction constant is applicable between 100° and 120°. Similarly the Arrhenius' Equation is applicable to this reaction. The value of the energy of activation as determined by the application of Arrhenius' Equation varies between 21000 and 26500 calories.

A probable mechanism based on the ionisation of the base has been proposed.

213. Condensation of ethyl acetoacetate with Aromatic Amines. Part III.

C. R. TALPADE and L. H GADGIL, Bombay.

The effect of the alcoholic component of the acetoacetic ester on the formation of the acetoacetarylides has been studied.

It is found that increase in the molecular weight of the alcohol increases the value of the velocity constant k. This is however accompanied by a decrease in 'E', the energy of activation, and 'P', the probability factor.

Further, the value of k is related to the proportion of the enolic form of the ester.

214. Condensation of ethyl acetoacetate with arylamines. Part IV.

C. R. TALPADE and L. H. GADGIL, Bombay.

The methods used for the preparation of acetoacetanilides are discussed in this paper. The suitability of the solvents like benzene, xylene is discussed. The condensation is best carried out in open flasks and with stirring, using equimolecular proportion of ethyl acetoacetate and the aniline.

215. Separation and Identification of the products of Decomposition of the Diazonium chlorides of certain Sulphonamides.

C. R. TALPADE and I. N. PATEL, Bombay.

The separation and identification of the products of decomposition of the decomposition of sulpanilamide, sulpha-acetamide, sulphaguanidine, and metanilamide has been studied. The diazonium chloride of sulphanilamide gives parachlorosulphonamide and parahydroxysulphonamide. The diazoniumchloride of sulpha-acetamide gives acetic acid in addition to the above two products. In the case of sulphaguanidine and metanilamide, the diazotised solutions give the corresponding hydroxy derivatives.

216. The Friedel-Crafts Reaction of Negatively Substituted Benzene derivatives.

B. C. JHA and G. C. AMIN, Ahmedabad.

The application of the Friedel-Crafts reaction to the benzene derivatives containing negative groups are few. In the present communication, halo-nitrobenzenes are studied. O-chloro- and o-bromo-nitrobenzenes under Friedel-Crafts benzoylation yield 4-chloro or 4-bromo-3-nitro-benzophenones while with acetyl chloride both yield the *same* ketonic compound devoid of the halogen group to which tentative structure 2-hydroxy-3-nitro acetophenone has been assigned. On the other hand no ketonic product could be obtained from p-chloro or p-bromo- and meta-bromo-nitrobenzenes.

217. Fries Migration of Esters of 2:4-Dibromophenol.

C. M. CHRISTIAN and G. C. AMIN, Ahmedabad.

The Fries migration of 2:4-dibromophenyl acetate, propionate and butyrate gave 3:5-dibromo-2-hydroxyacetophenone, propiophenone and butyrophenone respectively. The Friedel-Crafts acylation of 2:4-dibromophenol also gave the same products. The benzoate, however, gave a product which was not a ketone. Thus the two bromine atoms in the nucleus do not retard the Fries reaction.

218. Synthesis of 2′-Hydroxy Chalcone Derivatives.

KUMUD C. AMIN and G. C. AMIN, Ahmedabad.

5′-benzoyl-3′-methyl-2′-hydroxy chalcones have been synthesised by condensing 5-benzoyl-3-methyl-2-hydroxyacetophenone with aromatic aldehyde in presence of 40% potassium hydroxide. Incidentally 5′-benzoyl-3′-methyl-2′-hydroxy-4-methoxy chalcone was converted into 6-benzoyl-8-methyl-4′-methoxy flavanoid derivatives.

219. Preparation and Properties of Activated Urea.

T. N. MEHTA and M. S. MURTY, Nagpur.

Urea adduct of lauric acid was extracted with benzene in a Butt extractor for about 8 hours. The solid urea thus obtained was found to be more reactive than ordinary urea in its adduct forming tendencies. Hence it was given the name activated urea. Activated urea formed adducts with the fatty acids without the aid of any catalyst such as water or methanol.

220. Structure of di-iso-safrole.

C. N. HAKSAR, Gwalior.

Iso-safrole dimerises under suitable conditions to give a saturated dimer called di-*iso*safrole. Previous workers regarded this as a derivative of *cyclo*-butane. Baker and Enderby (*J. Chem. Soc.*, 1940, 1094) gave a hydrindene structure to metanethole, the saturated dimer of anethole. This has now attained a unique importance and depending upon this, all other saturated dimers of aryl propenyl compounds are now considered to be hydrindene derivatives. Pailer (*Montash*, 1947, 77, 45) has given a hydrindene structure to di-*iso*safrole also. Baker *et. al.* (*J. Chem. Soc.*, 1952, 4310) have further shown that the stereo-chemistry of the saturated dimers of the aryl propenyl compounds is most probably fixed, so that it was possible for them to convert metanethole, the saturated dimer from anethole, into di-methyl-*iso*eugenol, the saturated dimer from methyl-isoeugenol, by a series of chemical reactions. In order to study the stereo-chemical relationship between metanethole and di-*iso*safrole, the latter was treated with sodium in liquid ammonia, which brought about demythelenation of the methylenedioxy compound. The intermediate hydroxy compound could not be obtained in a crystalline form. The crude product, however, on methylation with dimethyl sulphate, gave a crystalline product melting at 98°, while metanethole obtained by dimerising anethole melts at 135°. Ultimate analysis of the methylated product indicated its identity with metanethole melting at 99°, which was obtained by Van der Zanden and de Varies (*Rec. Trav. Chim.*, 1949, *68*, 261). This may be due to the fact that the drastic process of demethylenation brought about a change in the stereo-chemical structure of the product.

221. Fractionation of chick hemoglobin on carboxymethyl-cellulose column.

B. N. MISRA and P. K. CHOUDHURY, Calcutta.

Carboxymethyl (CM-) cellulose, a cation exchanger has been prepared from indigeneous sulphite pulp and has been completely characterised. Ion exchange capacity of about 0 75 meq/gm. has been obtained. Chick hemoglobin has been successfully fractionated into two components (and possibly 3) on this cation exchanger.

222. Fusion of Chandrine with caustic soda.

MRS. BITHIKA BOSE, Calcutta.

Chandrine (Indian Pharmacist, 1954, 84-88) was heated with 20 per cent caustic soda over paraffin bath in a slow current of pure nitrogen till the mixture was perfectly dry. Heating was continued at higher temperature in an airbath till some fusion of caustic soda took place. All alkaline vapours liberated were carried over by nitrogen and absorbed in dilute hydrochloric acid contained in gas wash bottles which were placed in series also. Among the products of alkaline vapours pyridine was isolated and norharman was found in the undistilled residue in the reaction tube.

223. Syntheses of Furano Compounds, Part XVI. Thermal Cyclisation of cis o-Hydroxycinnamyl Alcohols.

J. N. CHATTERJEA, Patna.

A simple method of preparation of 1 :2-chromene and its derivatives has been developed by the pyrolysis of *cis-o*-hydroxy-cinnamyl alcohols. The expected 2-methylenecoumarans are not formed. It is shown that the formylation of chroman gives 6-formyl derivative. 2-Methyl-4 :5-benzocoumarone and 2-methyl-6 :7-benzocoumarone have been synthesised.

224. Syntheses of Furano Compounds, Part XV. 3-Acylisocoumaranones and the rearrangement of their Phenylhydrazones.

J. N. CHATTERJEA, Patna.

It is shown that the phenylhydrazones of 3-acylisocoumaranones undergo facile rearrangement to the related pyrazolones. The acyl derivatives have been prepared by the action of NN′-diarylamidines on isocoumaranone.

3 :4 :7 :8-Dibenzonaphthyrone has been obtained by the action of pyridine on isocoumaranone. s-Tris-coumaronebenzene and tribenzoyl-enebenzene have been similarly obtained. The preparation of some polymethine compounds derived from pyridine has been studied.

225. Action of bromine on N-phenyl-N′-p-tolyl thiocarbamide in chloroform.

R. H. SAHASRABUDHEY and K. S. SURESH, Varanasi.

Aromatic thiocarbamides react with bromine in chloroform giving benzthiazoles. By this reaction Hunter obtained from N-phenyl-N′-p-tolyl thiocarbamide a product melting indefinitely between 115 to 200° (*J. Chem. Soc.*, 1930, 2207). On reinvestigation we find that 10 gms. of the above thiocarbamide gave 6 gms. of the product which contained nitrogen, sulphur and bromine. It was not a hydrobromide. Crystals from alcohol m.p. 203°. Analysis gave N 8·9%. S 10·0% and Br 26·1%. Calculated for $C_{14}H_{11}N_2SBr$, N 8·7%, S 10·0% and Br 25%. It gave a picrate m.p. 250°.

By the condensation of p-bromo aniline with 2-chloro-6-methyl benzthiazole, 2-p-bromophenylamino-6-methyl benzthiazole was obtained. Crystals from alcohol m.p. 206°. It gave a picrate m.p. 251°. This was found identical with the product mentioned above through undepressed melting points of the mixtures of the original bases and the picrates. The same bromine substituted product was also formed by the direct bromination in chloroform of 2-phenylamino-6-methyl benzthiazole obtained by the condensation of aniline with 2-chloro-6-methyl benzthiazole.

The action of bromine on aromatic thiocarbamides in chloroform ordinarily leads to the respective benzthiazole perbromides. In the present case the thiazole initially formed has been brominated in the phenyl nucleus attached to position 2, the position 6 being blocked by the methyl group.

226. On Huggershoff's thiodiazole.

R. H. SAHASRABUDHEY and K. S. SURESH, Varanasi.

Bromine oxidation of thiocarbanilide in cold alcohol gave a base $C_{20}H_{20}N_4S.$, Fromm (*Annalen, 394*, 284).

On reinvestigation of Fromm's work we failed to obtain triphenylguanido benzthiazole; instead we got triphenylguanidine and 2-phenylamino benzthiazole. In other reactions, besides the reported products, we found carbanilide in considerable quantities. The "thiodiazole" formed a hydrobromide (anhydrous) m.p. 159-63° and a picrate m.p. 160°. Contrary to the observations of Fromm it could not be desulphided with alkaline lead oxide. It gave a low melting yellow nitroso derivative and was found reactive to sodium in cold ether.

These last mentioned properties suggested the presence of an active hydrogen, probably a secondary amino group, although the "thiodiazole" structure did not admit of any hydrogens excepting those of the four phenyl groups. On these reactions, and the easy formation of 2-phenylamino benzthiazole, carbanilide and triphenylguanidine from it, we conclude that the "thiodiazole" contains 2-phenylamino benzthiazole nucleus as a part of its structure with carbodiphenylimide condensed presumably, in position 3.

227. Action of bromine on tetraphenyl formamidine monosulphide hydrobromide.

R. H. SAHASRABUDHEY and K. S. SURESH, Varanasi.

It was reported (*These abstracts*, 1958, p. 134) that thiocarbanilide on oxidation with bromine in cold alcohol gave a lemon yellow product (m.p. 156°), probably the tetraphenyl formamidine monosulphide. On analysis it is found to have $C_{26}H_{23}N_4SBr$ and is, as evinced by its reactions, really the hydrobromide of the above monosulphide. Attempts at preparing the free base were unsuccessful. On standing with water it decomposed into phenylisothiocyanate and triphenylguanidine hydrobromide (m.p. 213°).

Action of bromine on this monosulphide hydrobromide, which appeared to be an intermediate in the oxidation of thiocarbanilide leading to the "thiodiazole", was studied in a dry chloroform medium. An orange yellow product melting at 143-150° was obtained. Determination of bromine showed 43·1% Br corresponding with the molecular weight 740 which closely agreed with $C_{26}H_{21.23}N_4SBr_4$. Three of its bromine atoms were found reactive towards potassium iodide. On reduction with sulphurous acid it gave a colourless product which proved to be $C_{26}H_{20}N_4S$, HBr the hydrobromide of Huggershoff's thiodiazole, the 3 :5-diphenylimino- 2 :4-diphenyl- 1 :2 :4-thiodiazole. The identity was established through the determination of the equivalent weight of the anhydrous hydrobromide (found 511, requires 501), and the undepressed melting points of the mixtures of the free base and its picrate with the authentic samples of each of them.

228. Action of sulphurylchloride on phenyl- and p-tolyl thiocarbamides.

R. H. SAHASRABUDHEY and K. S. SURESH, Varanasi.

The action of sulphuryl chloride on phenyl- and p-tolyl thiocarbamides in indifferent solvent media like benzene and chloroform, is known to give the hydrochlorides of 2-aminobenzthiazole and 6-methyl-2-aminobenzthiazole respectively (Allen and Allen, *Organic Syntheses*, 1942, *22*, 16; *These abstrats*, 1958, p. 135).

In the light of the results reported by Nambury (*These abstracts*, 1958, p. 136), the interaction of sulphuryl chloride was investigated on the above thiocarbamides at 0-10° in the above solvents. Formation of the hydrochlorides of the respective aryl formamidine disulphides was indicated as evidenced by the reactivity of the products towards absolute alcoholic solution of potassium iodide and their decomposition into the respective benzthiazole, "thiodiazole", sulphur and thiocarbamide. The products were, however, grossly contaminated with the hydrochlorides of respective benzthiazoles. The reaction, however, is of interest because it indicates that in the case of sulphuryl chloride also the "formamidine disulphide" salts are intermediate products leading to benzthiazoles finally.

229. Preparation of 2-chloro benzthiazoles.

R. H. SAHASRABUDHEY and K. S. SURESH, Varanasi.

Several methods have been reported for the preparation of 2-chlorobenzthiazole. Starting with 2-mercapto benzthiazole it has been obtained in 47% yield by the prolonged action (24 hours) of chlorine in acetic acid medium (Findlay and Dougherty, *J. Am. Chem. Soc.*, 1946, *68*, 1666) and in 55% yield by heating with phosphorus pentachloride (Drozdov and Stavroskaya, *J. Gen. Chem.* (U.S.S.R.), 7, 2813-18). It is also formed by the action of S_2Cl_2 in absence of any solvent (Clifford, U.S. Patent No. 2,043, 948). 2-aminobenzthiazole gives it in about 25% yield by steam distillation of its diazonium salt (Drozdov, *loc. cit.*). The first two procedures, where the yields are better, involve comparatively lengthy procedures.

It has now been found that 2-mercaptobenzthiazole on heating with sulphuryl chloride for 30 minutes at 60° and subsequent steam distillation gave nearly 50% yield of the 2-chlorobenzthiazole.

2-chloro-6-methyl benzthiazole was obtained from 2-amino-6-methyl benzthiazole by Sandmeyer's reaction. Use of cuprous chloride more than doubles the yield obtainable according to Hunter's procedure (*J. Chem. Soc.*, 1930, 2207). From 5 gm. of the 2-amino- compound this author obtained only 0·8 gm. of the 2-chloro product whereas we were able to obtain 6 gms. from 15 gms. of the starting material.

230. Oxidation of a mixture of phenyl thiocarbamide and thiocarbanilide.

R. H. SAHASRABUDHEY and K. S. SURESH, Varanasi.

Oxidation of mono- and di-substituted aromatic thiocarbamides in dilute alcoholic media with a variety of oxidizing agents is believed to give various 1 :2 :4. thiodiazoles (*Ber.*, *22*, 1176; *ibid.*, *36*, 3130; *J. Ind. Chem. Soc.* *14*, 477; *ibid.*, *19*, 25 etc.) Although quite a few compounds of this class are known, no definite proof has been furnished about their being thiodiazoles.

In order to throw light on the structure of these compounds bromine oxidation of a mixture of phenyl thiocarbamide and thiocarbanilide in alcohol was investigated. "Thiodiazole" corresponding to phenyl thiocarbamide was formed in traces only, while that related to thiocarbanilide was not formed at all. A mixture of two new bases (I) m.p. 216° and the other (II) m.p. 169° was obtained. On analysis (I) was found to have $C_{20}H_{16}N_4S_2$ while (II) agreed with $C_{20}H_{14}N_4S$. Thus (I) and (II) both appear to have been formed by the oxidative condensation of one molecule each of phenyl thiocarbamide and thiocarbanilide. The (II) gave a picrate m.p. 214°. The (I) on treatment with acetic anhydride gave a bright reddish orange product (III) m.p. 190° and phenyl mustard oil. Further work is in progress on these compounds.

231. Chemistry of some alkylammonium alkyl xanthates.

R. H. SAHASRABUDHEY and C. N. V. NAMBURY, Varanasi.

In the interaction of potassium ethyl xanthate with ethyl- and dimethyl-amines in an aqueous medium leading to the corresponding thiourethanes, formation of amine-xanthates was envisaged as an intermediary stage (*J. Vk. Univ.*, 1958, *II*(*I*), 101). By the direct interaction of ethyl xanthic acid with ethyl-, diethyl-, dimethyl- and benzyl-amines, the related amine-xanthates ($R_2\overset{+}{N}H_2\overset{-}{S}.CS.OEt$) have now been obtained, probably for the first time : ethylammonium-, diethylammonium-, dimethylammonium- and benzylammonium salts melt at 106, 79-81, 95-97 and 97-99°C respectively.

In aqueous solutions of the respective amines or more rapidly in presence of yellow lead oxide in ether, these amine-xanthates (excepting the diethyl compound) give rise to the corresponding thiourethanes; thus conclusively proving their intermediate role in the formation of thiourethanes (*loc. cit.*). On dry heating near their melting points they decompose into the amine-salts of respective dithiocarbamic acids, carbon disulphide and alcohol. It is interesting to note that the thiourethanes are completely excluded in this latter reaction. The amine-xanthates are rather unstable and deteriorate rapidly on storage forming a mixture of the respective thiourethane and amine-dithiocarbamate.

232. Interaction of certain amines with Bender's salt and dicarbethoxy disulphide.

R. H. SAHASRABUDHEY, C. N. V. NAMBURY and (MISS) KAMAL KAPOOR,
Varanasi.

The interaction of potassium ethyl xanthate with aromatic primary amines, leads to the formation of thiocarbanilides (*These Abstracts*, 1958, p. 145). With aliphatic amines thiourethanes (*These Abstracts*, 1958, p. 144; Nambury, *J. Vk. Univ.*, 1958, *II*(*1*), 101) are formed. The investigation has now been extended to Bender's salt and its oxidation product.

It has now been found that by the action of aniline, p-toluidine, benzylamine and α-naphthylamine with potassium ethyl monothiocarbonate—also called Bender's salt (EtO.CO.SNa) at 60-180°C for 1—1½ hours, the respective carbanilides are formed in 41, 24, 76 and 61% yields.

Aniline, benzylamine and α-naphthylamine reacted also with dicarbethoxy disulphide (EtO.CO S.S.CO.OEt), in ether or ether-alcohol medium, at ordinary temperatures to give diphenyl-, dibenzyl- and di-α-naphthyl-carbamides, in 100, 76 and 61% yields respectively.

Diethylamine reacted with dicarbethoxy disulphide in cold ether to give a viscous liquid, b.p. 78-80°C, probably diethylammonium ethyl monothiocarbonate. It gave diethylamine hydrochloride on treatment with HCl in cold benzene and on heating under reflux formed a liquid, b.p. 160°C, probably diethyl urethane. With Donlevy's reagent it gave a derivative identified with S-benzyl isothiuronium ethyl monothiocarbonate m.p. 90-91°C.

233. Isomeric amyloxides of tervalent iron.

R. K. MULTANI, Delhi.

Eight isomeric amyloxides of iron were prepared. Ferric n-amyloxide, ferric tri-2 methyl butoxide and ferric 3 methyl butoxide were prepared by both the ammonia method as well as the alcohol interchange method. Ferric tertiary amyloxide was prepared by the ammonia method using the pyridinium ferric chloride complex as the starting material. It was also prepared from alcohol interchange from ferric ethoxide. All others were prepared by alcohol interchange from ferric ethoxide. The molecular weights of these compounds were determined in benzene. The isomeric amyloxides of iron exhibited a marked increase in volatility from the primary to the secondary to the tertiary alkoxides. The same phenomenon was noticed in respect of their molecular complexities in boiling benzene. Thus the primary alkoxides are found to be trimers (with the exception of neopentyl oxide), whilst the secondary amyloxides are dimers and the tertiary amyloxide has a complexity of 1·5.

234. Polysaccharides from the kernel of green palmyra palm nut (Borassus flabellifer, Linn.).

A. MUKHERJEE, D. CHOUDHURY and P. BAGCHI, Jadavpur.

The polysaccharide was isolated by precipitation of an aqueous extract of the kernel with acidified alcohol. After purification it was obtained as an amorphous white powder having the following characteristics :

Pentosan = 0·4% ; Ash = 0·36% ; Moisture = 10·9%. The polysaccharide was difficultly soluble in water. The water solution was found to be neutral, hence it was concluded that there is no uronic acid residue in it. This was later confirmed by chromatography of the hydrolysed product. The polysaccharide on hydrolysis with 2N Sulphuric acid on a water bath for twenty-four hours gave sugar mixture which on paper partition chromatography using different irrigating solvents revealed the presence of mannose and galactose only. The polysaccharide, therefore, appears to be a galactomannan. Investigations are in progress for the elucidation of the detailed structure of the polysaccharide.

235. On the constitution of Mesuol—Part II.

D. P. CHAKRABORTY and P. K. BOSE, Calcutta.

Further investigations on the structure of mesuol (Dutta, Deb and Bose, J. Ind. Chem. Soc., 1940, *17*, 277 and Chakraborty and Bose, Proc. Ind. Sci. Cong., 1958, 139) has revealed the following:

(i) It can me methylated with diazomethane to a dimethyl derivative ($C_{25}H_{26}O_5$, m.p. 132°).

(ii) The infrared spectrum of dimethyl mesuol shows the presence of the following groups (a) hydroxyl, (b) six-membered lactone, (c) *gem*-dimethyl, (d) *iso*-propylidene and (e) unsubstituted phenyl nucleus.

(iii) Dimethyl mesuol can be hydrogenated to its tetrahydro-derivative ($C_{25}H_{30}O_5$, m.p. 122-23°).

(iv) It yields on alkali degradation two alkali-soluble products (a) $C_{18}H_{14}O_4$, m.p. 189°C and (b) $C_{20}H_{18}O_4$, m.p. 268°C. The ultra-violet absorption spectra of the compounds have features similar to those of 5:7-dihydroxy 4-phenyl coumarin (Bull. Soc. Chim. Fr., 541, 1955).

Mesuol can be degraded with 5%, 10%, 20% aqueous caustic potash and in every case acetophenone is obtained. Dimethyl mesuol on oxidation with neutral permanganate gives benzoic acid and oxalic acid. On degradation with chromic acid dimethyl mesuol yields acetone while tetrahydro mesuol affords acetophenone. Ozonolysis of dimethyl mesuol gives acetone and formic acid.

Phloroglucinol is obtained by fusion of mesuol with caustic potash at 200-210°C. Mesuol may be a complex derivative of 5:7 dihydroxy-4-phenyl coumarin containing an *iso*-propylidene group.

236. Polyphenols from Aegiceras majus Gaertn.

K. VENKATESWARA RAO and P. K. Bose, Calcutta.

During our work on the triterpenoid sapogenins from the bark of *A. majus* Gaertn (Proc. Ind. Sci. Congress, 1958, Part III, 174) it was noticed that hydrolysis of the saponin also yielded a flavonol, $C_{15}H_9O_6.OCH_3$, m.p. 300° (decomp.) Rf 0·80 (n-butanol-acetic acid-water, 4:1:1) and 0·72 (Phenol satd. with water); Absorption (in ethanol): λ max. 255 and 375 mμ (log. ϵ max. 4·40 and 4·44 resp.). It formed a tetraacetate of m.p. 207-8° and on methylation gave quercetin pentamethyl ether. Demethylation with hydriodic acid yielded quercetin characterised as its acetate. It appears, therefore, that the flavonol is isorhamnetin, which may be present as a glycoside.

A polyphenolic acid, $C_{16}H_{18}O_9$, m.p. 208° has also been isolated from the bark in low yield.

237. Chemistry of 'Gum Guggul'.

K. VENKATESWARA RAO and P. K. Bose, Calcutta.

In the course of our chemical study of some Indian plant resins (*Vide* Trans. Bose Res. Inst., 1956-57, XXI, 23), 'Gum Guggul' has also been examined and three crystalline compounds, β-sitosterol, a neutral substance of m.p. 226° and a methyl ester of the acidic fraction, m.p. 68-70° were isolated. The neutral constituent seems to be a diterpenoid and contains no acylable hydroxyl group but formed an oxime, m.p. 240-2° (decomp.). It gave positive Zimmermann and Ehrlich's reactions and its ultraviolet absorption spectrum showed a maximum at 242 mμ. Further work is in progress.

238. Organic Fluorine Compounds—Part II. Synthesis of a conjugated Fluoro-Allene.

G. V. ASOLKAR, Nagpur.

A general method of preparation of fluoro-allenes has been reported earlier (cf. Proc. Ind. Sci. Congr., 1958, (Late abstracts), Part IV, p. 20). The method is now extended to the preparation of a conjugated allene. Using 1 :2-dichloro-trifluoroiodoethane, $CF_2Cl.CFClI$ as a source of polyfluoroalkyl radical ($CF_2Cl.CFCl.$) (in place of the trifluoromethyl CF_3. used in the earlier work), the free radical addition reaction with propargyl chloride $CH{\equiv}C.CH_2Cl$ is studied. From this the mono-addition product $CF_2Cl.CFCl.CH:CI.CH_2Cl$. is obtained in 87% yield. The dehalogenation of this product with zinc and ethanol gave an allene in 52% yield b.p. 57°, n_D^{20} 1·406 and having a molecular weight of 122 (C_5H_3F, the expected conjugated allene 4 :5 :5-trifluoro-penta-1 :2 :4-triene, $CF_2:CF.CH:C:CH_2$ requires M, 120). The infra red spectrum shows allenic bonds at 5·04 (weak) and an intense band at 5·11μ and olefinic type C :C absorption at 5·66 μ, 5·77 μ. The ultra-violet and infra red spectra of the various compounds studied, and the difficulties of the analysis of the conjugated allene are presented and discussed.

239. Synthesis of diarylmethylmalonates and analogous compounds.

S. D. GUPTE and S. V. SUNTHANKAR, Bombay.

The reactions of arylmagnesium bromides with ethoxymethylenemalonate, ethoxymethylenemalanonitrile and ethoxymethylenecyanoacetate were studied to prepare β-arylmethylenomalonates and diarylmethylmalonates and analogous nitriles and cyanoesters, required for the synthesis of polycyclic compounds. The forward additions of equimolecular proportions of arylmagnesium bromide to ethoxymethylenemalonate gave intractable oils. The reverse addition of ethoxymethylenemalonates to grignard compounds, however, gave diarylmethylmalonates in good yields. Similarly, diarylmethylcyanoacetate and diarylmethylmalononitriles were obtained in high yields by the reverse addition of respective esters to arylmagnesium bromides. This one step procedure of the preparation of diarylmethylmalonate from the commercially available esters is more convenient than that used by Newman and Flanagan (J. Org. Chem., 23 (1958), 792), in which several steps are involved starting from the preparation of inaccessible aromatic aldehydes.

The reverse addition of ethoxymethylenemalonate to phenyllithium carried out for comparison, gave a compound (m.p. 215°) which was identified as a bis-carbinol, formed by both 1 :2 and 1 :4-addition of the reactive organolithium compound.

240. Synthesis of substituted Quinoline derivatives and separation of Isomers.

A. G. MUNSHI, Bhuj.

Recently a large number of substituted 4-amino quinoline derivatives, having anti-malarial properties, have been synthesised and reported. With the idea that the introduction of the bromine atom and methoxy group may enhance the activity of the drug, 5 & 7-bromo-6-methoxy-4-hydroxy quinolines are synthesised, by Conard and Limpach method, i.e. using ethyl-oxalacetate and necessary aromatic amine. The 5 & 7-bromo isomers are separated by repeated fractional crystallisation.

241. Studies on Anodic Synthesis in the Preparation of Organic Compounds. Part I.—The Preparation of Aliphatic Alcohols.

J. K. MEHROTRA and A. N. DEY, Kanpur.

The modified method of anodic synthesis developed by Linstead *et al* (J.C.S., p. 3331, 3333 (1950); ibid, 1130, 2854 (1951); ibid, 3261, 3824 (1952) has been examined for the preparation of aliphatic alcohols, and the preparation of following alcohols have been described. The combination of the acids used in each case and the yield have been also reported.

Acids used		Alcohol obtained	Yield
Phenyl acetic acid	Phenoxy acetic acid	Phenyl ethyl benzene	13·7%
Lauric „	Glycollic „	Lauryl alcohol	27·4%
Myristic „	„ „	Myristyl alcohol	24·7%
Palmitic „	„ „	Oetyl alcohol	13·7%
Lauric „	Lactic „	Triddecanol-2	20·0%
Myristic „	„ „	Pentadecanol-2	22·4%
Palmitic „	„ „	Heptadecanol-2	13·2%

242. 2:6-Diaryl-3-ethoxycarbonyl-4-piperidones and their N.Methyl derivatives.

P. N. BHARGAVA and I. D. SAXENA, Banaras.

Six new N-methyl-2 :6-diaryl-3-ethoxycarbonyl-4-piperidones have been synthesised and converted into pyrazolone derivatives.

243. Synthesis of 2-arylimino-3-aryl-4 or 4:5-substituted Thiazolines.

P. N. BHARGAVA and SHIV NAYAK SINGH, Banaras.

Several 2-arylimino-3-aryl-4 or 4 :5-substituted thiazolines have been synthesised and the resulting thiazoline compounds have been mercurated. The position of the acetoxy mercuri group in the molecule has been fixed up. These mercurated derivatives have been assayed for their fungicidal action. Further work is in progress.

244. 2-Arylimino-3-aryl-4-methyl-5-carbethoxy thiazolines and their acetoxymercuri derivatives.

P. N. BHARGAVA and A. P. BHADURI, Banaras.

A number of 2-arylimino-3-aryl-4-methyl-5-carbethoxy thiazolines have been synthesised and the resulting compounds have been mercurated. The position of the mercuriacetoxy group in these compounds is ascertained. These mercurated compounds will be assayed for bactericidal and fungicidal action for practical purposes. The work is in progress.

245. 2-o-Phenetylimino-3-o-phenetyl-4-thiazolidone and its various derivatives.

P. N. BHARGAVA and R. C. KAPOOR, Banaras.

2-o-Phenetylimino-3-o-phenetyl-4-thiazolidone has been obtained by condensing monochloroacetic acid with S-di-o-phenetylthiourea. The thiazolidone decomposes quantitatively into S-di-o-phenetyl urea on boiling with KOH. On treatment with aromatic aldehydes and aryl-diazonium chlorides, 5-substituted arylidene and arylazo derivatives have been respectively obtained. On oxidation with $KMnO_4$ a sulphone is obtained. The work is in progress.

246. Studies on 2-o-chlorophenylimino-3-o-chlorophenyl-4-thiazolidone.

P. N. BHARGAVA and I. D. SAXENA, Banaras.

2-o-Chlorophenylimino 3-o-chlorophenyl-4-thiazolidone has been synthesised from S-di-o-chlorophenyl thiourea and monochloroacetic acid in the presence of anhydrous sodium acetate and absolute alcohol. During studies on the effect of reaction conditions on the preparation of the thiazolidone, it has been found that the best yield is obtained by employing the amount of monochloroacetic acid slightly in excess than the required molar proportion and refluxing the reaction mixture for 4 hours. On treatment with acid, it hydrolyses into the corresponding thiazolidione. On treatment with aromatic aldehydes and aryldiazonium chlorides, arylidene and arylazo-derivatives showing a $-CH_2$ group in the molecule have been obtained. On oxidation a sulphone is formed. All the above results establish the constitution. Further work is in progress.

247. Pyridino-anthraquinones : Part II—Pyridine catalysed one step synthesis of Pyridino-anthraquinones.

K. SIVASANKARAN and S. V. SUNTHANKAR, Bombay.

In an attempt to synthesise some pyridino-anthraquinones, the reaction of aminoanthraquinones and ethyl acetoacetate was studied. When the two reactants were heated in xylene at reflux temperature, no reaction took place. However, when α-amino-anthraquinone, ethyl acetoacetate (excess) and little amount of pyridine were refluxed for four hours, the product isolated was found to be 2′-4-hydroxy-4′-methyl-1(N) :2-pyridino-anthraquinone, formed in one step, involving both condensation and cyclization. Similarly 1-amino-4-methoxy anthraquinone gave the cyclized product. The reaction of 1 :5-diaminoanthraquinone carried out analogously gave the monocondensed monocyclized product i.e. 2′-hydroxy-4′-methyl1(N) : 2-pyridino-5-aceto-acetamido-anthraquinone. Similar reactions carried out with simple amines have failed to give the cyclized products. The role of pyridine in the one step synthesis of pyridino-anthraquinones is discussed.

248. The structure of Acacia Sundra Gum—Part II. Structure of the Degraded Gum.

S. MUKHERJEE and A. N. SHRIVASTAVA, Kanpur.

The degraded Acacia sundra gum which forms the basic nucleus of the whole gum, to which the labile sugar residues are attached glycosidically, was obtained by its autohydrolysis. The degraded gum is reducing in nature and consists of a repeating unit of 10 residues of galactose and 4 of glucuronic acid. Hydrolysis of the methyl ester of the methylated degraded polysaccharide furnished 2,3,4-tri-O-methyl-D-Galactose (6 moles) ; 2,4,6-tri-O-methyl-D-galactose (1 mole) ; 2,4-di-O-mehtyl-D-galactose (3 moles) and 2,3,4-tri-O-methyl-D-glucuronic acid (4 moles), the structures of which were proved by paper partition chromatography, demethylation studies, determination of methoxyl content and preparation of suitable derivatives. On the basis of the identification of the methylated derivatives and their respective molecular proportions a structure has been suggested.

249. Constitution of Sugar Cane Wax—Part II. Composition of the saturated fatty acids in the fatty matter of the cane wax.

S. MUKHERJEE and Y. P. KAPIL, Kanpur.

The crude wax obtained by solvent extraction from the press cake was first deashed. Fatty portion of the deashed wax was extracted with alcohol. The fatty portion (30%) still contained some wax which was removed by diffusion into acetone. Calcium soap of the dewaxed fat was prepared; this on refluxing with glacial acetic acid gave free fatty acids. The free fatty acids were resolved into saturated and unsaturated fatty acids by the lead salt method. Saturated fatty acids were esterified with methyl alcohol and the mixture fractionally distilled under vacuum. Saponification equivalent and Iodine value of the different fractions was determined and from this data the composition of the saturated fatty acids was found out. It is as follows :—Palmitic acid 15·4% ; Stearic acid 10·2% ; Oleic acid 1·6% ; Arachidic acid 22·5% ; Behenic acid 6·2% ; Higher than Behenic acid 44·1%.

250. Chemical Examination of Palm Fruit (Borassus Flabellifer) Nature of the Sugars present in the Kernel.

A. K. CHATTERJEE and S. MUKHERJEE, Kanpur.

The Palm tree commonly known as Tal or Tad is found almost in all parts of India. It yields fruit which is of yellowish-black colour. The aqueous extract of the palm kernel was found to contain sucrose and fructose when examined on a paper chromatogram. The two components were separated by column chromatography and identified by preparing their suitable derivatives. The fibrous polysaccharide of the Kernel on acid hydrolysis afforded mannose only which was identified by preparing N-phenyl mannosamine. It shows that the polysaccharide is a mannan and the palm kernel may prove to be a rich source of mannose. Total sugar content in the kernel is 30·3% out of which 21·2% is mannose.

251. Synthesis of Polynuclear hydrocarbons.

ARUN KUMAR DAS GUPTA and BISWAJIT SINHA, Jadavpur.

A new, general and short method has been developed to build up crysene and picene derivatives.

For the synthesis of chrysene, $\Delta^{1:9}$ octalin-2-one was condensed with β-phenylethylbromide in presence of pot. t-amylate in dry benzene. 1-(β-phenylethyl)-$\Delta^{1:9}$-octalin-2-one thus obtained was cyclised with polyphosphoric acid to furnish 1, 2, 3, 4, 5, 6, 12, 12a-octahydro chrysene. The U. V. studies ($\lambda_{\text{max}}^{\text{EtOH}}=277$ mμ, log $\varepsilon=4{\cdot}18$) confirmed its styrene structure. This on dehydrogenation afforded chrysene.

Similarly for the synthesis of Picene, $\Delta^{1:9}$-octalin-2-one was condensed with β (1-naphthyl) ethylbromide in presence of t-amylate in dry xylene. 1-(β-1′-naphthyl ethyl) $\Delta^{1:9}$-octalin-2-one thus obtained was cyclised with poly-phosphoric acid to afford 1, 2, 3, 4, 4a, 5, 13, 14 octahydropicene. The light absorption studies ($\lambda_{\text{max}}^{\text{EtOH}}$ $=280$ mμ, log $\varepsilon=4{\cdot}2$) confirmed the styrene structure for this as well. This on dehydrogenation with palladised charcoal furnished Picene.

252. Synthesis of some Nitro-phenoxazines.

A. B. SEN and A. K. ROY, Lucknow.

Several nitro-phenoxazines containing alkyl and/or halogen groupings have been synthesised with a view to studying their tuberculostatic activity.

The nitro-phenoxazines were prepared by the ring closure of the corresponding diphenyl-amines with sodium hydroxide following the method of Ullmann and Sane (Ber., 1911, *44*, 3735). The required diphenyl-amines were obtained from the corresponding dinitro-chloro- compound by condensing with 2-amino phenol, 4-methyl-2-amino phenol and 4-chloro-2-amino phenol.

The following diphenyl amines and phenoxazines have been prepared :—

	DIPHENYLAMINES	M.P.	PHENOXAZINES	M.P.
1.	2′hydroxy-2,4-dinitro-5-methyl-6-iodo	122	1-iodo-2-methyl-3-nitro	183
2.	2′hydroxy-5′-methyl-2,4-dinitro-5-methyl-6-iodo	110	1-iodo-2,8-dimethyl-3-nitro	*
3.	2′hydroxy-5′-chloro-2,4-dinitro-5-methyl-6-iodo	68	1-iodo-2-methyl-8-chloro-3-nitro	225
4.	2′hydroxy-5′-chloro-2,4-dinitro-5-ethyl	195	2-ethyl-8-chloro-3-nitro	220
5.	2′hydroxy-5′-methyl-2,4-dinitrophenyl-α-naphthylamine	210	8-chloro-3-nitro-1,2-benz	*
6.	2′hydroxy-5′-chloro-2,4-dinitrophenyl-α-naphthylamine	190	8-chloro-3-nitro-1,2-benz	*
7.	2′-hydroxy-1,6-dinitro-phenyl-β-naphthylamine	155	3′nitrobenz-3,4	*
8.	2′hydroxy-5′-methyl-1,6-dinitrophenyl-β-naphthylamine	166	8-methyl-3′nitrobenz-3,4,-	262

* Melting Point above 300.

253. Coumarins and Alkaloids of the Root of Aegle marmelos Correâ.

B. CHAUDHURI, S. GHOSH and A. CHATTERJEE, Calcutta.

From ether extract of the root of Aegle-marmelos Correâ a compound, m.p. 186-188°, marmin (1 : 3-dihydroxy-geranyl-umbelliferone), umbelliferone and skimmianine (4 :7 :8-trimethoxy furoquinoline) have been isolated. The occurrence of the latter three components in the immatured stem-mark of the same plant was reported earlier by one of the authors but the yield of these compounds in the root was found to be high as would be evidenced from the following: Marmin, m.p. 124-25°; Stem-bark 0·08%; Root-bark 1·1%; Umbelliferone, m.p. 232°, Stem-bark 0·02%, Root-bark 0·1%; Skimmianine, m.p. 176°, Stem-bark 0·003%, Root-bark 0·1%.

Hydrochloric acid washings of the ether extract yielded skimmianine upon basification and alkali digest of the same extract gave umbelliferone upon acidification. During ether extraction of the plant-materials, marmin (0·9%) separated out. A further quantity of marmin (0·2%) was obtained from skimmianine and umbelliferone-free ether solution when the residue obtained from the latter upon evaporation was dissolved in benzene, chromatographed over alumina and the column was washed with ethyl acetate. The benzene eluents gave a neutral compound, m.p. 186-88°, further purification and studies of which are in progress.

The chloroform extract of the root left after ether treatment showed positive tests for alkaloids,

254. Separation and identification of hydroxy acids present in Shellac by means of unidimensional Paper Chromatography, Part II.

S. C. SEN GUPTA, Ranchi.

To separate, identify and estimate the various hydroxy acids present in shellac by the help of paper chromatography, preliminary work was undertaken with hydrolysed *Kusmi* seedlac. Seedlac was severally hydrolysed at room temperature with (i) 0.5*N* alcoholic (50%) caustic potash in presence of sodium sulphite, (ii) 0.5*N* aqueous caustic potash in presence of sodium sulphite, (iii) 0.5*N* aqueous potash and (iv) 5*N* aqueous caustic potash only. All these four solutions were used for running the chromatograms by the descending technique in the solvent systems (A) n-butanol saturated with 2 *N* ammonia solution and (B) 95% ethyl alcohol—liquor ammonia (100 :4). Altogether seven acid spots were obtained in each cases; the corresponding spots were very similar in nature and size. Of the spots four have been tentatively identified as due to aldehydic, shellolic, aleuritic and butolic acids, the spots due to the first two acids being very prominent. The presence of sodium ion caused some interference retarding the Rf values of the acids. The Rf values of the various acids as recorded in solvent system 'A' were 0.09-0.10, 0.16-0.18, 0.21-0.23, 0.28-0.30, 0.41-0.42, 0.47-0.49 and 0.59-0.60 respectively while those in 'B' were 0.14-0.15, 0.41-0.45, 0.49, 0.56-0.57, 0.62-0.64, 0.69-0.70 and 0.73-0.75 respectively.

255. Synthesis and Reactions of 2-Amino Benzothiazoles.

P. N. BHARGAVA and B. T. BALIGA, Banaras.

A series of 2-amino benzothiazoles have been synthesised by condensing As-aryl thioureas with bromine in chloroform. Treatment with acetyl and benzoyl chlorides gave the corresponding 2-acetyl and 2-benzoyl amino benzothiazoles. Diazotisation and coupling with alkaline β-naphthol resulted in the formation of the corresponding 2-azo -β-naphthol benzothiazoles. Oxidation with sodium hypoellorite was shown to yield 2 :2′-dibenzoazothiazoles.

256. Studies on Optical Resolution of 3-(2-Methyl-phenoxy)-Propane-1:2-diol ($CH_3.C_6H_4.O.CH_2.CHOH.CH_2\text{-}OH$).

KUMAR THAKER and (Miss) SARLA PATEL, V. V. Nagar.

In the action of drugs, it has been shown that optical isomers possess different physiological properties like the case of d-adrenaline which is twelve times as active as dextro-variety.

Mephenesin, 3-(2-Methyl-phenoxy)-Propane-1 :2-diol, ($CH_3.C_6H_4.O.CH_2.CHOH.CH_2OH$) has been used as a muscular relaxant. It is proposed to see the optical isomers of this compound for their muscular relaxant property after resolution.

This compound is converted into its hydrogen phthalate by reaction with phthalic anhydride and the acid ester is resolved through its quinidine salt. Further work on its physiological activity is in progress.

257. Synthetic studies in Diterpenes.

D. NASIPURI, Calcutta.

The formation of trimethyloctahydrophenanthrene derivatives related to some naturally occurring diterpenes by the cyclodehydration of easily accessible unsaturated alcohols as reported earlier, has now been extended to effect a synthesis of 1 :2 :3 :4 :9 :10 :11 :12-octahydro-7-methoxy-1 :1 :12-trimethylphenanthrene. Methyl 5-oxo-8-*m*-methoxyphenyloctanoate obtained by hydrolysis of ethyl α-*m*-methoxyphenethyl-β-oxo-pimelate followed by esterification, was treated with excess methylmagnesium iodide and the resultant diol was cyclodehydrated by Polyphosphoric acid to afford the expected compound as a viscous oil, b.p. 145-147°/·01 mm. The unsaturated alcohol prepared by the action of 3-m-methoxyphenylpropylmagnesium bromide on methylheptenone was likewise cyclised to the same compound. Recently, Barltrop and Rogers have isolated the *trans*-isomer of this compound in crystalline forms, m.p. 52-55°, from the cyclodehydration product of *cyclo*-hexanol derivative. Similar results are also expected in these cyclodehydration processes. Experiments for the isolation of crystalline trans-isomer are being continued.

258. Synthesis of Ethyl 6-Carboethoxy-6-methyl-3-Oxocyclohex-1-enyl-β-propionate.

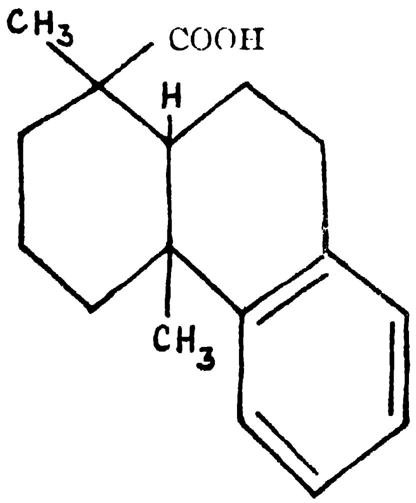
S. BHATTACHARYA, J. ROY, and D. NASIPURI, Calcutta.

It was felt that ethyl 6-carboethoxy-6-methyl-3-oxo*cyclo*hex-1-enyl-β-propionate would serve as a valuable synthetic intermediate in the steroid field, with its adipic acid structure serving as a latent *cyclo*pentanone ring. Robinson and Seijo first prepared this compound in very poor yield (8%) by the condensation of 4-diethylaminobutan-2-one methiodide with ethyl α-methyl-β-oxoadipate in the presence of Sodium methoxide in pyridine. We found, however, that by employing ethanolic potassium ethoxide (slight excess) as condensing agent, the yield was improved to the extent of 40-45%. The product obtained as viscous oil, b.p. 160-165°/0·5 mm. gave no ferric reaction. Use of methyl vinyl ketone in place of the Mannich-base methiodide with trace of bases as catalysts, gave poorer yield. The structure of the product, however, should be accepted with reserve as there is an alternate possibility of cyclisation. Experiments to settle the strcture are in progress.

259. Studies on the Stereochemistry of Tricarbocyclic Resin Acids.

U. R. GHATAK and N. K. BASU, Calcutta

An excellent method has been developed for the synthesis of methyl 1-β-phenyl ethyl 2 :6-demethyl Δ^6cyclohexene-2-carboxylate (II, Howarth and Barker, J. Chem. Soc., 1299, 1939) from 2- (β phenyl). 3-methylΔ^2-cyclohexanone (Stork and Burgstahler, J. Am. Chem. Soc., *73*, 3544, 1951).



(I)

The unsaturated ester (II) on cyclisation with polyphosphoric acid and subsequent hydrolysis yielded three crystalline stereoisomeric acids (I) with melting points 232-233° (a); Howarth *et al,* loc. cit.) 206-207 (b); Parham, Wheeler and Dodson, J. Am. Chem. Soc., 77, 1166, 1955) and 167° (c).

The methyl ester of the acid (a; m.p. 131-32°), on oxidation with chromic acid acetic acid yielded a mono keto ester crystallised in two polymorphic forms m.p. 124-25 and m.p. 148-49°, ($\lambda_{\text{max}}^{\text{alc}}$ 251 mμ, log ε =4·08) D.N.P. m.p. 219-20°, and the methyl ester (84-85°) of the acid (b) on similar oxidation yields a yellow diketo ester (m.p. 129-30°). The diketo ester was converted to a gummy enol-acetate ($\lambda_{\text{max}}^{\text{alc}}$ 259 mμ, log ε =4·039) and which on catalytic hydrogenation with Pd/C in acetic acid solution containing perchloric acid yielded a crystalline ester (m.p. 131-132°) identical with the ester of the acid (a).

From the rate of the hydrolysis of the ester (a) and the oxidation studies (Wenkert and Jackson, J. Am. Chem. Soc., *80,* 211, 1958), the acid (a) was confirmed to be *trans*-desoxy podocarpic acid, and the acid (b) as *cis*-desoxy podocarpic acid.

The acid with the structure (I) m.p. 146-47° described by Saha, Ganguly and Dutta (Chem. & Ind., 412, 1956) was proved to be *cis*-desisopropyl dehydroabietic acid from the oxidation studies (Wenkert *et al,* loc. cit.), which yielded a yellow diketone.

260. Synthetic studies in Diterpenoids.

P. K. RAMCHANDRAN and N. G. KUNDU, Calcutta.

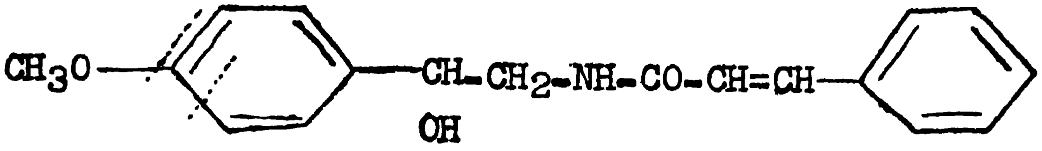
A simple method has been developed for the synthesis of ethyl-γ-(6-methyl-6-carbethoxy-3-one-Δ-cyclohexenyl)-butyrate (I), from which it is expected to build up the bicyclic ketones (Sondheimer, *59,* 7742, 1957), important intermediates for the synthesis of di- and tri-terpenoids.

2-Methyl-2-carbethoxy cyclohexanone was condensed with ethyl-γ-bromo crotonate (Bachman *et al,* J. Org. Chem., *13,* 317, 1948) in presence of zinc, and the resulting ester reduced catalytically. The saturated hydroxy ester (b.p. 165-67°/0.6 mm.) was dehydrated and the product on oxidation with sodium dichromate and acetic acid yielded the product (I), (b.p. 158-162°/0·2 mm.; $\lambda_{\text{max}}^{\text{alc}}$ 237 m, log ε 3·97) in a good yield.

261. The Constitution, Stereochemistry and Stereospecific Synthesis of Aegeline, a natural alkaloidal amide of Aegle marmelos Correâ.

A. CHATTERJEE, S. BOSE and S. K. SRIMANY, Calcutta.

Aegeline, the neutral compound isolated from the leaves of *Aegle marmelos* Correâ, has the molecular frmula, $C_{18}H_{19}O_3N$. Upon alkali fusion, aegeline decomposes to produce benzoic, anisic, and p-hydroxy benzoic acids the latter arising from anisic acid by demethylation. On treatment with periodic acid the compound gives rise to benzaldehyde and anisaldehyde. Benzaldehyde is also obtained when aegeline is subjected to the process of ozonolysis. Upon hydrolysis with concentrated hydrochloric acid, aegeline undergoes hydramine fission to furnish anisaldehyde, cinnamic acid and a volatile base identified through its picrate as methylamine. All these degradation products can be explained if aegeline is assigned the structure (I).



(I)

The above structure is also confirmed by synthesis. The geometrical stereochemistry of aegeline has also been studied. The U.V. spectrum of the compound as well as its I.R. spectrum, particularly in the =C=C= stretching region and the "trans band region" at 990-965 cm^{-1} establish the trans configuration of aegeline.

262. Synthesis of 2-arylamino-5-thiazolyl methyl Ketone—Action of Monoaryl-thioureas on acetyl-acetone.

G. N. MAHAPATRA, Cuttack.

In the present paper, action of acetyl acetone on various monoaryl-thioureas such as pheny, o-toly, o- and 2-chlorophenyl, p-carboxy phenyl and α-naphthyl thioureas has been studied in presence of iodine. In all these cases, 2-arylamino-5-thiazolyl methyl ketones are formed. The presence of the acetyl group at the Carbon atom 5 of the thiazole nucleus has been ascertained by various evidences.

263. Mercuration of 2-Phenylimino-3-Phenyl-4-thiazolidone.

G. N. MAHAPATRA, Cuttack.

In the present paper, 2-phenylimino 3-Phenyl-4 thiazolidone has been mercurated with help of mercuric acetate and the position of the acetoxy-mercuric group in the molecule has been ascertained. It has been found that under the ordinary conditions, only one acetoxy mercuri group enters the molecule and attaches to the phenyl nucleus in the para-position, attached to the imino group at C_2 position.

264. Bromination of 2-amino-thiazoles with help of N-Bromosuccinimide.

G. N. MAHAPATRA, Cuttack.

Seventeen 2-amino-4-aryl-thiazoles synthesized earlier (Mahapatra, J. Ind. Chem. Soc. 33, 527, 1957) have been brominated by N-Bromo-succinimide in carbon tetrachloride medium under ordinary conditions. The advantage of the use of N-bromosuccinimide over direct bromination has also been discussed.

265. Studies on Jaborandi Alkaloids : Part III. A New Synthetical Route for the Preparation of Pilosinidine.

J. K. MEHROTRA and A. N. DEY, Kanpur.

In a previous communication (Dey and Tewari, Proc. Ind. Sci. Congr., 1943) a direct method for the synthesis of some of the Jaborandi alkaloids had been reported. However the method gave unsatisfactory yield of the final product in most cases as it involved a number of steps. In this paper a second method has been described which is free from such limitations and has furnished pilosinidine in satisfactory yield. For the purpose of Ethyl γ-Phthalimide acetoacetate has been condensed with 1-ethoxy-3-syane propene-2 to give a condensation product which for the present purpose was not isolated but hydrolysed to give easily amine methyl homopilosinyl ketone in an yield of 60% of the theory. The latter on condensation with potassium thiocyanate gave 60% yield of 2-thiol-pilosinidine (inactive). The latter on oxidation with hydrogen peroxide gave pilosinidine in good yield (in this connection see also N. A. Preobrazenskii et al, C.A., *47,* 4345 (1953); ibid, *43,* 2625 (1949)).

266. Iminazole Series. Part I.—The use of Phthalimido Acetoacetic esters for the Preparation of Iminazoles.

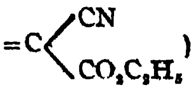
S. N. DIXIT, J. K. MEHROTRA, S. D. VERMA and A. N. DEY, Kanpur.

Amine ketones required for the preparation of iminazoles are obtained by methods involving a number of steps or using difficultly available chemicals or involving the use of comparatively hazardous chemicals, e.g., diazomethane, which, in effect, put limitations to large scale operation. In this paper comparatively an easier method of preparing the same has been described which is free from these defects. For the purpose ethyl γ-phthalimidoacetoacetate already prepared by Gabriel (Ber., 1244, *42* (1909); ibid, 1706, *46* (1913) has been used. However the yield of the ester by the published method is very poor and it had to be improved considerably (72% of theory) by using magnesium in place of sodium for the condensation of phthalimido acetyl chloride and diethyl malonate. Similar condensations of phthalimido acetyl chloride with other mono substituted malonic esters have furnished the corresponding phthalimido acetoacetic esters. The acid hydrolysis of these esters furnished the corresponding amino ketones whose condensation with potassium thiocyanate yielded the thiol iminazoles, oxidation of which gave the iminazoles concerned. In this way the 3(or) methyl, ethyl, n-propyl, benzyl and hydroxy ethyl iminazoles have been prepared showing that the method is a general one for the preparation of such compounds.

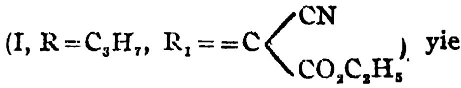
267. Synthetic Studies in Resin Acid.

M. SHARMA and P. C. DUTTA, Calcutta.

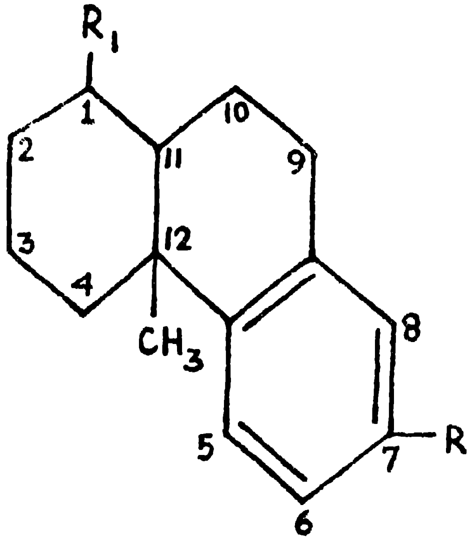
A method has been developed in this laboratory for the introduction of gem-methyl carboxylic acid residue in the place of the carbonyl group in the tricyclic compound (I) [Saha, Ganguli and Dutta, Chem. & Ind., 412, 1956].



The method has been successfully utilised for the synthesis of methyl dehydroabietate. The ketone (I, R C_3H_7, R_1 O) on condensation with ethyl cyano-acetate yielded a gummy product, I, R$=C_3H_7$, $R_1 = =C\begin{cases}CN \\ CO_2C_2H_5\end{cases}$) b.p. 205-210°/·4 mm. The cyano-compound obtained through the conjugated addition of hydrocyanic acid to



$(I, R=C_3H_7, R_1==C\begin{smallmatrix}\diagup CN \\ \diagdown CO_2C_2H_5\end{smallmatrix})$ yielded the dicyano compound b.p. 205-215°/·4 mm. which on hydrolysis with acetic acid, sulphuric acid and water yielded a crystalline dibasic acid m.p. 202°). The dibasic acid is converted to the corresponding dimethyl ester (b.p. 175-180°/·4 mm.) with diazomethane which on partial hydrolysis with



methanolic caustic potash solution yielded half-ester (m.p. 159-160°). This half-ester was converted to silver salt and subjected to Hunsdiecker degradation. It yielded a bromo-ester which on reduction with zinc-dust and acetic acid yielded an oily product which is being characterised as it is expected to be methyl dehydroabietate.

268. Synthetic Studies in 4-methylisoquinolines.

N. N. SAHA, G. BANDYOPADHYAY and P. K. DUTTA, Calcutta.

The synthesis of 1 :4 :ψ-trimethyl-3 :4-dihydroisoquinoline (I) and its picrate m.p. 179° was reported (Saha, Dutta and Mukherji, Science & Culture, *18*, 152, 1952). In order to elucidate the structure of (I) and also to study the orientation in the Fridel-Crafts reaction involved in the above synthesis, the condensation product was oxidised with alkaline potassium permanganate to give a mixture of phthalic acids of which the orthoisomer was identified only through phthalein test but could not be isolated in any significant amount. Iso and Terephthalic acids could however, be isolated through their Barium salts (Smith, J. Amer. Chem. Soc., *43*, *1920*, 1921) and identified through their dimethyl esters (Found : Dimethyl-isophthalate, m.p. 64-65°, lit., m.p. 67-68 (64-65°); Dimethyl terephthalate, m.p. 141-142°, lit., m.p. 141-142°) showing the presence of significant amounts of meta and para isomers in the Friedel-Crafts condensation product.

Further more to elucidate the structure of (I) β-(p-tolyl) propylamine was acetylated to give N-Acetyl-$\beta\beta$-(4-methylphenyl methyl) ethylamine a colourless liquid b.p. 150-152°/3-4 mm. This on cyclodehydration furnished 1 :4 :7-trimethyl-3 :4-dihydroisoquinoline a pale, yellow liquid b.p. 102-105°/2-3 mm. identified through picrate, m.p. 208-209° different from that of (I) which definitely establishes that (I) is not 1 :4 :7 as expected but must be either 1 :4 :5 or 1 :4 :6 or 1 :4 :8 trimethyl-3 :4-dihydroisoquinoline.

269. Synthetic approach towards Triterpenoid Intermediates.

S. A. NARANG, Jadavpur.

The synthesis of the lactone of 5 :9-dimethyl-10-hydroxy-6-carboxy-decalin-1-one (I) and 5 :9-dimethyl-10-hydroxy-6-carbmethoxy-decalin-1-one (II) is being described and these are expected to be important intermediates for the total synthesis of triterpenoids. Haegemann's ester was condensed with ethyl γ-bromobutyrate to 3-methyl-4-carbethoxy-2-(γ-carethoxypropyl)-Δ^2 cyclohexenone (b.p. 180-185°/5·0 mm.). On catalytic hydrogenation, it leads to 3-methyl-4-carbethoxy-2-(γ-carethoxypropyl)-cyclohexanone, D.N.P.H., m.p. 122-123°). On Grignard reaction with magnesium methyl iodide, dehydration and hydrolysis, it afforded 1 :3-dimethyl-4-carethoxy-2-(γ-carboxypropyl)-cyclohexene. This, on ring-closure with Zinc chloride, acetic anhydride and acetic acid gave a compound which on infra-red studies showed the well defined bands for saturated γ-lactone (5·65 μ), six-membered ketone (5·82 μ) and ester (5·8 μ). The lactone of 5 :9-dimethyl-10-hydroxy-6-carboxy-decalin-1-one was separated by treating the ring closure product with ethanlic potassium hydroxide and heating the acidic material with hydrochloric acid. The neutral portion (b.p. 145°/0·5 mm.) was separated which was found to be a lactone. The remaining acidic portion was esterified with diazomethane to (II) (b.p. 150-152°/0·5 mm.).

270. Synthesis of 1:4-Dimethyl-$\Delta^{1:9}$-bicyclo(5:3:0)-decen-2-one.

J. R. MAHAJAN and A. K. MANDAL, Calcutta.

1 :4-Dimethyl-$\Delta^{1:9}$-bicyclo (5 :3 :0)-decen-2-one, a potential synthetic precursor for some important members of the guaianolides group (azulenogenic lactones), has been synthesised by the following scheme in a satisfactory overall yield.

The condensation product from ethyl-ε-bromocaproate and ethyl methylmalonate was hydrolysed and subsequently esterified to afford ethyl-α-methyl suberate. On ring closure under high dilution technique, it gave 2-methyl-7-carethoxy-cycloheptanone. Condensation with ethyl-α-bromopropionate and subsequent hydrolysis of the condensation product with methanolic baryta yielded the corresponding acid, which was smoothly converted in satisfactory yield to 1 :4-dimethyl-$\Delta^{1:9}$-bicyclo(5 :3 :0)-decen-2-one, by the action of methylmagnesium iodide on the corresponding enol alctone and subsequent ring closure. 2 :4-dinitrophenylhydrazone, m.p. 175-17§°; Semicarbazone, m.p. 166°).

271. Synthesis of 5-Hydroxyoxindole.

S. GHOSAL and A. CHATTERJEE, Calcutta.

Stollé (Ber., *47*, 2120 (1914)) first observed that α-haloacetanilide upon heating with anhydrous aluminium chloride cyclised resulting in oxindole with elimination of hydrogen halide. This method has been extended by the present authors in the synthesis of various oxindole derivatives. Following the procedure of Stollé 5-methoxyoxindole has been attempted to prepare by cyclising p-methoxy-α-chloroacetanilide with anhydrous aluminium-chloride. The synthesis of 5-methoxyoxindole was undertaken with a view to preparing several indole derivatives. The reaction proceeded smoothly, but, instead of 5-methoxyoxindole, the corresponding 5-hydroxy derivative was obtained. This demethylation was due to anhydrous aluminium-chloride which is a well known reagent for demethylating phenolic ethers. But Giovannini and Portmann reported in 1948 (Helv. Chim. Acta, *31*, 1381 (1948)), that p-methoxy-α-chloroacetanilide upon ring closure with anhydrous aluminium-chloride gave 5-methoxyoxindole. The present authors believe that the compound isolated by Geiovannini and Portmann from cyclisation products is 5-hydroxyoxindole but not its methyl ether.

272. Stereospecific reduction of Yohimbone with Sodiumborohydride.

S. GHOSAL and A. CHATTERJEE, Calcutta.

The reduction by sodium borohydride of ketones which can yield diastereomeric alcohols has been the subject of numerous investigations. It is felt desirable to see whether such isomers are formed during the reduction of yohimbone with sodiumborohydride.

B. Witkop (Ann., *554*, *110* (1943), studied the Meerwein-Pondorff reduction of yohimbone and isolated from the reduction products two epimeric alcohols, viz., yohimbol, m.p. 243°) and epi-yohimbol (m.p. 258°) by fractional crystallisation M. Janot et al have repeated this experiment and separated the isomers by chromatographic resolution over alumina. Yohimbol shows absorption in its I.R. spectrum at 1000 cm^{-1}, characteristic for axial orientation of the hydroxyl group, and epi-yohimbol shows absorption peak at 1040 cm^{-1}, showing that the hydroxyl group in this compound is equatorial. The present authors have reduced yohimbone with sodium borohydride and a single compound, m.p. 248-49° (uncorrected) has been obtained in almost quantitative yield. It is chromatographically homogeneous and the infra-red spectrum of the compound is found to be identical with that of epi-yohimbol, showing thereby that yohimbone upon treatment with sodium borohydride undergoes stereospecific reduction giving rise to only one epimer where the hydroxyl group is equatorial.

273. Terpenoids of Leuconotis Eugenifolia DC.

A. CHATTERJEE, B. DAS and S. K. ROY, Calcutta.

Chemical examination of the leaves of *Leuconotis eugenifolia* DC. (Fam. *Apocyanaceae*) revealed the presence of several triterpenic constituents from which lupeol acetate (yield, 0·00017%) and a sapogenol (yield, 0·0017%), m.p. 214·15°, $[\alpha]_D^{32\cdot5} = +53\cdot9°$ have been isolated in pure and homogeneous state. Elementary analysis of this sapogenin, its acetate and benzoate suggests the molecular formula of the substance as $C_{30}H_{50}O$. From a study of its molecular formula, optical rotation and melting points of the sapogenol and its acetyl and benzoyl derivatives, the compound appears to be a new compound and has been designated as *Leuconol*. With tetranitromethane it produces a yellow colouration indicating the precence of an isolated double bond which is found to be reluctant to catalytic hydrogenation.

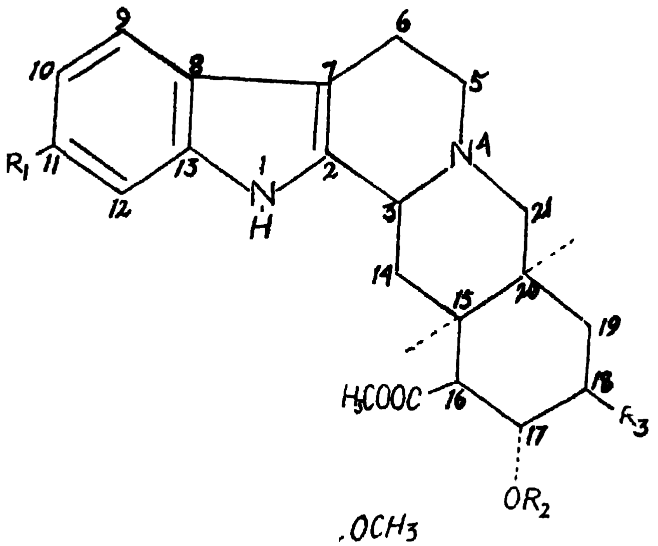
274. Correlation between Chemical Constitution and Reserpine-like Activity. Part II. Synthesis of Rescinnamine Analogue of Rauwolscine.

S. K. TALAPATRA and A. CHATTERJEE, Calcutta.

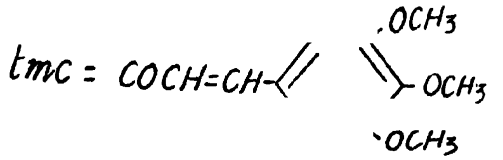
In continuation of our studies on the correlation of chemical constitution with reserpine-like activity the rescinnamine analogue (I) of rauwolscine (II) has been synthesised. 3,4,5-Trimethoxycinnamic acid required for the purpose has been prepared in good yield as follows:

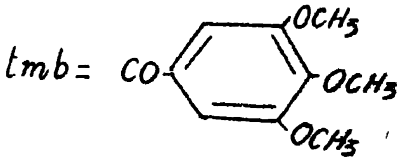
3,4,5-Trimethoxybenzanilide was converted to 3,4,5-trimethoxybenzaldehyde by the method of Sonn and Müller [Ber., *52*, 1927 (1919)] in a satisfactory yield (nearly 60%). The latter on Doebner condensation with malonic acid yielded

3,4,5-trimethoxycinnamic acid (80% yield) which was converted to its acid chloride by thionylchloride.



	R_1	R_2	R_3
I.	H	tmc	H
II.	H	H	H
III.	OCH_3	CH_3	Otmc
IV.	H	tmb	H
V.	OCH_3	CH_3	Otmb
VI.	H	CH_3	Otmb
VII.	H	H	Otmb
VIII.	OCH_3	H	Otmb
IX.	H	tmb	OH
X.	OCH_3	CH_3	OH





Rauwolscine (II) upon condensation with 3,4,5-trimethoxycinnamoyl chloride in pyridine yielded a gummy mass, the neutral fraction of which on chromatographic resolution gave the desired rescinnamine analogue of rauwolscine which crystallises from methanol in fine colourless needles, m.p. 252° (dec.). The introduction of the trimethoxycinnamoyl moiety in rauwolscine molecule decreases the basicity of the latter.

Pharmacological study of 3,4,5-trimethoxycinnamoyl rauwolscine (I) shows that it possesses strong hypotensive properties comparable to that of the alkaloid rescinnamine (III), but unlike the latter the former has no sedative action. Previously the same behaviour has been shown by reserpine analogue (IV) of rauwolscine [Chatterjee and Talapatra, J. Sci. Industr. Res., *14C*, 237 (1955)]. From a comparison of the structures of reserpine (V), deserpidine (VI), rescinnamine (III), raunescine (VII) and pseudoreserpine (VIII) which have got both hypotensive and strong sedative actions with those of isoraunescine (IX), methyl reserpate (X) and its different synthetic esters at C_{18}, and also the analogous synthetic compounds (I) and (IV) which have been found to possess hypotensive but no tranquilising property, it is concluded that only trimethylgalloylation or 3,4,5-trimethoxycinnamoylation at C_{18} can initiate the reserpine-like activity (sedative action) in the molecule.

275. Studies on the Alkaloids of Rauwolfia Sumatrana (Miq.) Jack.

A. CHATTERJEE, N. ADITYA CHAUDHURY and S. GHOSH MAJUMDAR,
Calcutta.

The crude alkaloid mixture isolated from the ethanol extract of the roots of *Rauwolfia sumatrana* Miq. Jack. was separated into three fractions: fraction A (very weakly basic), fraction B (weakly basic) and fraction C (strongly basic). Paper chromatography of fraction "A" using n-butanol : formic acid : water (10 :2 :3) system indicated the presence of ajmaline (Rf, 0·70), rauwolscine (Rf, 0·75) and yohimbine (Rf, 0·61). Paper chromatography of fraction "B" using n-butanol saturated with N/10 hydrochloric acid system indicated the presence of aricine (Rf, 0·83) and δ-yohimbine (Rf, 0·87). Fraction "C" showed the presence of serpentine (Rf. 0·72) and an unidentified alkaloid (Rf. 0·68) using n-butanol : formic acid : water (10 :2 :3). The alkaloids were located on the over-dried papers (90°, 1 hour) by their fluorescence and also by spraying with Dragendorff's reagent.

Further work on the isolation and characterisation of these compounds is in progress.

276. Bodying of Linseed oil.

A. N. SAHA, Calcutta.

Linseed oil has been bodied by passing the oil through a molten eutectic salt mixture consisting of 53% KNO_3, 7% $NaNO_3$, 40% $NaNO_2$. The oxidised and polymerised portion insoluble in acetone can be separated by centrifugation. Salt mixture under the conditions of experiment loses certain amount of its oxygen.

277. On the Constitution of the Anthoxanthine Glycosides of Parsley (Apium petroselinum) and the synthesis of Apigenin.

M. O. FAROOQ, I. P. VARSHNEY, W. RAHMAN and MOHD S. Y. KHAN, Aligarh.

The seeds of Parsley (Apium petroselinum) have been found to contain two glycosides, apiin (Apigenin-7-apiosyl-glucoside) and a glycoside of Diosmetin (Diosmetin-7-apiosyl-glucoside) in an approximate ratio of 1 :1. The third component has been found to be present in traces only. Apigenin obtained in the above work was identified by comparison with an authentic sample prepared by a new route starting with 4,6-dimethoxyphloracetophenon and anisaldehyde in alkaline medium, followed by Selenium dioxide oxidation and demethylation.

278. Deviations of Merocyanines derived from Benzothiazole and substituted Rhodanines.

M. K. ROUT, B. K. PATNAIK and P. K. MISRA, Cuttack.

In the present investigation, a series of vinylogous merocyanines ($n=o$, 1, 2, 3) derived from substituted rhodanines and benzothiazole have been described. Their absorption maxima have been measured and their deviations calculated after taking into consideration the absorption maxima data for the corresponding symmetrical cyanines and oxonols. The effect of increasing the chain length (by addition of vinyl group) on the deviation in the above merocyanines has also been determined.

279. Study of the reaction of Aromatic Aldehydes with 5-Methyl-4-Thiazolidones.

A. S. MITTRA and M. K. ROUT, Cuttack.

Several 5-methyl-2-arylimino-4-thiazolidones have been prepared by reaction of α-chloropropionic acid with monosubstituted thioureas by the method of Rout et al

(*J.* Am. Chemical Soc., 1955, *77*, 2427). These have been condensed with aromatic aldehydes and the nature of the products investigated by study of ultra-violet spectra and bromination experiments. The possibility of formation of benzylidene type of compounds similar to those formed with unsubstituted thiazolidones containing reactive methylene group has been ruled out. The results of ultra-violet measurements and bromination experiments establish that aldol-type of compounds are produced by the reaction between aromatic aldehydes and 5-methyl-thiazolidones.

280. Unsymmetrical Methin Cyanines derived from 4-Methyl-3-aryl1,2 Dihydrothiazole-2-thione.

PRANABANDHU TRIPATHY and M. K. ROUT, Cuttack.

In the present investigation, some unsymmetrical methin cyanines derived from 4-methyl-3-aryl-1,2 dihydro thiazole-2-thione as the fixed component and four other basic nuclei (2-methyl benzoxazole, lepidine, 2-methyl 4-phenyl thiazole, 2-methyl benzimidazole) as the variable second component have been prepared and their absorption maxima measured. These studies were carried out with a view to determining the relative basicity of the variable basic nuclei employed.

281. Synthesis of Biguanides as potential Hypoglycemic Agents. Part I.

U. P. BASU and T. N. GHOSH, Calcutta.

Slotta and Tschesche (*Ber. dtsch Chem. Ges.*, 1929, *62B*, 1398) in the year 1929 reported on the oral hypoglycemic action of some alkyl derivatives of biguanides. In recent years, consequent on the discovery of arylsulphonylureas as hypoglycemic agents, interest has been revived in the synthesis and evaluation of a number of mono- and disubstituted alkyl derivatives of biguanides. With this object in view the synthesis of substituted biguanides has been undertaken by the present authors. When *p*-toluene sulphonate of 2-phenylethylamine is reacted with dicyandiamide at an elevated temperature, the *p*-toluene sulphonate of N^6-phenylethylbiguanide is obtained. Attempts to isolate the base from this salt, under various conditions tried, have so far failed. However, when 2-phenylethylamine hydrochloride is heated with dicyandiamide at an elevated temperature, N^6-phenylethylbiguanide hydrochloride is obtained. This method has been applied for the synthesis of the hydrochlorides of some substituted biguanides, the substituents being CH_2Ph, CH_2-C_6H_4-SO_2-NH_2, etc.

282. Search for new Antispasmodics. Part VIII.

T. N. GHOSH and A. RAYCHAUDHURY, Calcutta.

3-Phenyl-3-benzylidene-propan-2-one (I) (Goldschmidt and Krezmar, *Monatsh*, 1897, *18*, 437; 1898, *19*, 406; 1901, *22*, 657), when subjected to Mannich reaction with formaldehyde and piperidine hydrochloride, has furnished the hydrochloride of 4-phenyl-4-benzylidene-1-piperidino-butan-3-one (II). Hydrogenation of (II) over Pd-C has yielded 4-phenyl-4-benzyl-1-piperidino-butan-3-one (III). (III) on reduction with aluminium *iso*propoxide has furnished 4-phenyl-4-benzyl-1-piperidino-butan-3-ol (IV). (I) has been hydrogenated over Pd-C to form 3-phenyl-3-benzyl-propan-2-one (V). (V) undergoes Mannich reaction with formaldehyde and piperidine to give a base assigned the structure, 3-phenyl-3-benzyl-3-piperidino-methyl-propan-2-one (VI). The structure (VI) has been confirmed by the positive colour reaction as developed by Adachi (*J. Chem. Soc. Japan, Pure Chem. Sect.*, 1950, *71*, 566) for methyl ketones and also by the observation that (VI) is not identical with the isomer (III), obtained by an unequivocal method.

283. Unsymmetrical Methin Cyanines derived from Quinoline and Pyridine.

BHASKER DAS and M. K. ROUT, Cuttack.

In the present investigation, two series of unsymmetrical methin cyanines formed by reaction of one of the following—2-methyl benzothiazole, 2-methyl-4-p-bromophenyl thiazole, 2-methyl-4-phenyl thiazole and 2-methyl benzimidazole with (i) quinoline ethiodide, (ii) 2-iodo pyridine ethiodide have been described. Their absorption maxima have been measured, with the object of evaluating the relative order of basicity of the variable basic nuclei used.

284. Constitution of Aspidospermine.

M. K. ROUT, Cuttack.

A more absolute method, i.e. pyrolytic decomposition of the labelled methiodide formed by combination of the alkaloid with C-14 tagged methyl iodide was used for the detection of the controversial function, N-Methyl group. Retirement of the N-Methyl hypothesis led to re-examination of all possible structures for aspidospermine. Evidences rejecting eserine-like structure and structures involving N_b connected to beta-indolinic position have been adduced. Results of Emde and Von Braun degradations and the nuclear magnetic resonance spectra of the degradation products have been discussed and a partial structure of aspidospermine has been proposed.

285. Mercurated Dyes : Mercury Derivatives of some Azoic Dyes.

J. K. SAXENA, V. S. SEVADE and A. N. DEY, Kanpur.

In connection with the study of fungicidal and germicidal properties of mercurated dyes the mercurated derivatives of the following azoic dyes have been prepared through the stages indicated below.

The mercurated derivatives of the bases, KB base, TR base and Scarlet Red base have been diazotised and coupled with Naphthol AS, Naphthol ASBS, Naphthol ASBO and Naphthol ASG to furnish the corresponding mercurated azoic dyes. The dyeing property and the anti-microbiological property of these dyes are under study.

286. Certain Carboxy Derivatives of some Anils of 4,4′-Diamino Diphenyl Sulphone.

R. K. GUPTA, J. K. MEHROTRA, H. L. ROHATGI and A. N. DEY,
Kanpur.

Howard (Biochem. J., 1938, pp. 1101) has shown the effectiveness of some anils of 4,4′-diamino-diphenyl sulphone for streptococcal and other infections of mice. It was considered that a soluble form of these and similar compounds would render them in a form for wider scope for applications and as such they may have chance to show useful physiological activity. With this end in view the anils were obtained by condensing 4,4″-diamino diphenyl sulphone with benzaldehyde, p-hydroxy benzaldehyde, p-methoxy benzaldehyde, p-hydroxy benzaldehyde and o-hydroxy benzaldehyde and the products formed were condensed in turn with succinic anhydride and phthalic anhydride. And thus the following products have been obtained :

4-benzylidene amine 4-amino diphenyl sulphone, 4-benzylidene-amino-4′ β-carboxy propionomide phenyl sulphone, 4-benzylidene-amino-4-succinimide-diphenyl sulphone, 4-benzylidene-amino-4′-O-carboxy benzamide diphenyl sulphone, 4-benzylidene amino-4′-phthalimido diphenyl sulphone, 4-p-hydroxy benzylidene amino-4′-amino diphenyl sulphone, 4-p-hydroxy benzylidene amino-4′-β-carboxy propionamide diphenyl sulphone, 4-p-hydroxy benzylidene β-amino-4′-succinimido diphenyl sulphone 4-p-hydroxy benzylidene amino-4-o-carboxy-benzamido diphenyl sulphone, 4-p-hydroxy benzylidene-amino-4′-phthalimide diphenyl sulphone, 4-p-methoxy benzylidene amino-4′-O-carboxy benzamido diphenyl sulphone, 4-p-methoxy-benzylidene-amino-4′-phthalimido diphenyl sulphone, 4-ortho-hydroxy benzylidene-amino-4′-amino diphenyl sulphone.

287. Response of different Phenolic Compounds towards Sakaguchi reaction for Arginine.

KSHIROD R. BHATTACHARYA and JYOTIRINDRA DATTA, Calcutta.

In the present investigation, carried out to test the specificity of Sakaguchi reaction towards the phenolic component, phenol and various substituted phenols as well as derivatives of α-naphthol, β-naphthol and oxine were subjected to extensive trial for colour production with arginine in presence of potassium hypobrimite. It was noted that the naphthols, oxine and a few of their derivatives were not unique in their response to this test, phenol and several substituted phenols being equally able to give this reaction ; the aromatic hydroxy compounds with a benzene ring usually gave a yellow colour, whereas compounds with a naphthalene or a quinoline ring gave a red to orange colour. It was also observed that the compounds, in which the position *para* to the hydroxyl was occupied by alkyl, aryl, sulphonic, carbonyl, amino or substituted amino groups were unable to produce colour by the above reaction. However, when the *para* position was occupied by an halogen atom, the reaction sometimes took place depending on the other substituents in the ring. Substitution in positions other than the *para* to the hydroxyl group usually intensified the colour. The findings are in general agreement to our suggested structure for the final coloured compound reported earlier. Among the compounds tested, thymol and enteroquinol, besides oxine, gave sufficiently intense colour to be of possible use as substitutes for α-naphthol in the usual Sakaguchi method for estimating arginine; the naphthol, because of some undesirable side reactions, has some limitations in this respect.

288. Chemical examination of the stem bark of Sesbania Grandiflora.

RAM DAS TEWARI and S. S. KHANNA, Allahabad.

From the alcoholic extract of the bark of Sesbania Grandiflora, an aromatic brown coloured compound melting point 210°C and having the molecular formula $C_{27}H_{28}O_8$ has been isolated. The compound adds on 4 atoms of bromine in glacial acitic acid solution, forming $C_{27}H_{28}O_8Br_4$ and the debromination of the compound gives $C_{27}H_{24}O_8Br_2$ by Zeisel method the presence of two methoxy groups have been established. On oxidation it gives three different acids. The structure of these oxidation products and of the parent compound are under investigation.

289. Examination of the Starch from the Kernel of Water Chestnut (Trapa bispinosa Roxbg.).

V. L. N. MURTY, D. CHOUDHURY and P. BAGCHI, Jadavpur.

The Kernel of water chestnut is found to consist of starch. The polysaccharide was isolated by macerating the Kernel in the presence of ethanol. The crude material was worked up according to the procedures of Cowie and Greenwood and of Aspinall, Hirst and McArthur. The product obtained by the former procedure was found to have the following characteristics :

$[\alpha]^{32}_{D} = +123^{\circ}{\cdot}4$ (C, 0·77% in N NaOH); Moisture 7·668%; Ash 0·072% and Nitrogen nil. Its X-ray photograph confirmed to a pattern of the A-type. The iodine binding capacity of the product revealed the presence of amylose content around 10%. The product was separated into amylose and amylopectin fractions using thymol as the precipitant for the amylose.

Its hydrolysis product with 2N sulphuric acid for 24 hours revealed the presence of glucose only by paper partition chromatography. The aqueous ethanol extract of starch before hydrolysis gave a spot on the chromatogram corresponding to galactose.

290. Synthetic Routes to Isoprenoid Compounds. Part II.

MOHINDRA S. CHADHA, Bombay.

As a part of the programme on the synthesis of isoprenoid compounds for testing as precursors of polyisoprenoid componds in plants, the synthesis of 2-methylbutane-1,2,3,4-tetrol was carried out.

2-Methylbutane-1, 2, 3, 4-tetrol was synthesised by three different routes. For the first route, *trans*-1, 4-dibromo-2-methyl-2-butene was the starting material, which on hydroxylation, using performic acid gave, 1,4-dibromo-2-methylbutane-2, 3-diol. The bromohydrin on treatment with anhydrous potassium hydroxide gave 2-methylbutane-1, 2, 3, 4-*bis*-epoxide, the latter on ring opening resulted in the tetrol. For the second route, *trans*-2, methyl-2-butene-1,4-diol was brominated to give 2,3-dibromo-2-methylbutane-1,4-diol the latter on treatment with potassium hydroxide gave the *bis*-epoxide, which in turn gave the tetrol on ring opening. Lastly, *trans*-2-methyl-2-butene-1, 4-diol diacetate was treated with performic acid to give the intermediate saturated ester, which on ester interchange resulted in *erythro*-2-methylbutane-1,2,3,4-tetrol in excellent yield. The last procedure gave the best results.

2-Methylbutane-1, 2, 3, 4-tetrol was found to be an efficient nutrient and a good source of latex in growing seedlings of the latex producing plant, *Cryptostegia grandiflora.*

291. Synthetic Routes of Isoprenoid Compounds. Part I.

MOHINDRA S. CHADHA, Bombay.

Several isoprenoid triols were synthesised for plant growth experiments as possible precursors of polyisoprenoid compounds. The four isomeric methylbutane triols which were synthesised were : 2-methylbutane-1, 2, 4-triol, 3-methylbutane-1, 2, 3-triol, 2-methylbutane-1, 2, 3-triol and 3-methylbutane-1, 2, 4-triol.

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[*] Biology Division, Atomic Energy Establishment Trombay, Indian Cancer Research Centre, Parel, Bombay 12.

[+] Work carried at the Baker Laboratory, Cornell University, Department of Chemistry, Ithaca, N.Y., U.S.A.

2-Methylbutane-1, 2, 4-triol was prepared by the reaction of 3-methyl-3-buten-1-ol or its acetate with performic or peracetic acid, followed by ester interchange of the intermediate hydroxy esters. Ester interchange was found to be more efficient than the saponification of the intermediate esters. 3-Methylbutane-1, 2, 3-triol was prepared similarly from 2-methyl-3-buten-2-ol or 3-methyl-2-buten-1-ol acetate, using performic acid. Likewise, 2-methylbutane-1, 2, 3-triol and 3-methylbutane-1, 2, 4-triol were obtained from 2-methyl-2-buten-1-ol and 2-methyl-3-buten-1-ol, respectively.

The plant growth tests were made with all the above triols using *Cryptostegia grandiflora* seedlings grown in an artifical medium in the absence of light. All the compounds were well tolerated by the seedlings and 2-methylbutane-1, 2, 4-triol appeared to be particularly effective as an organic nutrient and as a source of latex.

292. Studies on Macralstonine, and Alkaloid of Alstonia macrophylla Wald.

S. K. TALAPATRA and N. ADITYA CHAUDHURY, Calcutta.

The present authors have isolated from *Alstonia macrophylla* Wall occurring in Indian *Apocynaceous* plants, an alkaloid macralstonine, $C_{44}H_{54}O_5N_4$, in a yield of 0.06 per cent and have studied some of its properties.

Occurrence of this alkaloid in the same *Alstonia* species was first observed by Sharp [J. Chem. Soc., 1227 (1934)]. Macralstonine crystallises from alcohol in fine colourless needles, m.p. 275-76° (dec.) without any solvent of crystallisation. It is highly soluable in chloroform and pyridine, sparingly so in acetone and alcohol and almost insoluble in other organic solvents. Macralstonine produces an immediate navy blue colour with Frohde's reagent, a reddish-violet colour with Hopkin-Cole reagent and a wine-red colour with ceric sulphate and conc. H_2SO_4. The first two colour reactions suggest it to be an indole alkaloid.

Macralstonine is free from methylenedioxy group and contains one methoxyl and at least two C-methyl functions. N-methyl data suggests the presence of three or four such groupings. The base is optically active, dextro-rotatory in chloroform, $[\alpha]^{30}_{D} = +25.8^\circ$ and laevorotatory in pyridine, $[\alpha]^{30}_{D} = -22.5^\circ$. The base forms a number of salts, viz., pale-yellow amorphous hydroiodide, m.p. 262-64° (dec.), colourless perchlorate, m.p. above 300° (dec.), yellow chloroplatinate decomposing above 300° without melting, and yellowish-brown amorphous picrate, m.p. 205-6° (dec.); but none of these could be prepared in well crystalline forms, neither consistent analytical data were obtained.

The U.V. spectrum of the base in alcohol shows only one absorption maximum at 230 mμ (log ϵ, 4·85). The I.R. spectrum studied in nujol-mull exhibits characteristic absorption peak at 3420 cm^{-1} ($\rangle$NH or-OH), 1652 and 1628 cm^{-1} (possibly due to an ester conjugated with a vinyl ether), 1382 cm^{-1} (C-methyl), 816 cm^{-1} and 745 cm^{-1} (O-disubstituted benzene nucleus).

BIOCHEMISTRY

293. Strepogenin like activity of six edible varieties of Bombay fish.

S. R. MANKIKAR and KAMALA SOHONIE, Bombay.

Purified proteins from six common varieties of Bombay fish were prepared and their strepogenin like activity was tested towards L. casei. All the six proteins showed the presence of strepogenin like activity and it was found to be roughly half that present in casein.

294. Metabolism of oil in the germinating seeds—Part I. Groundnut seeds.

R. D. PATEL and L. F. RABARI, Vallabh Vidyanagar.

The metabolism of oil of Groundnut seeds during germination period has been studied. Characteristics of oil, composition of mixed fatty acids of oil and composition of seeds at various stages of germination are reported. It has been concluded from the experimental data that (i) component fatty acids of oil are metabolized in a non-selective manner, (ii) oleic acid is utilized more rapidly and (iii) reducing sugar which was absent in orignal seeds, sucrose and starch increases due to the transformation of oil into glucides during the germination period.

295. Free Amino Acids in goat's milk during different stages of lactation.

T. BARNABAS and R. B. MAWAL, Ahmednagar.

The qualitative and semiquantitative occurrence of free amino acids in non-protein extracts of goat's milk during different stages of lactation have been studied by paper chromatographic method. Fourteen samples of milk of a local breed of goat known as "Khilari", collected over a period of 61 days after post-partum have been studied. In all the samples analysed Arginine, Glycine, and glutamic acid were found to be very prominent. Cystine, lysine, serine, alanine, tyrosine, phenyl alanine, aspargin, leucine and isoleucine were also found to be present. Up to the 7th day cystine concentration was lower. Tyrosine and leucine-isoleucine were not detected in the milk samples of the first three days. The concentration of aspargin was observed to be more in the milk samples collected on the first four days after post-partum. The predominance of non-essential amino acids over essential ones in the non-protein extract of this milk is an interesting observation.

296. On the Mineral constituents in goat's milk during different stages of lactation.

T. BARNABAS and R. B. MAWAL, Ahmednagar.

The qualitative and semiquantitative occurrence of inorganic ions in the milk of a local breed of goat known as 'Khilari' have been studied in fourteen samples collected over a period of sixty-one days after post-partum, by chromatographic and usual chemical methods. Results show a decrease in concentration of iron and aluminium one week after post-partum. Of alkaline earths and alkali metals, calcium was very prominent compared to magnesium, sodium and potassium. The pattern of distribution of the above minerals except calcium during different stages of lactation was similar. A steady increase in calcium concentration up to the sixth day and then a steady decline up to the nineteenth day of lactation was noted. The concentration of iron up to the sixth day was somewhat higher than in mature milk. Iron content of the milk of this breed of goat is higher than that reported by Seidler in another breed. The phosphorus content is also higher in colostrum and in intermediate milk than in the mature milk. The higher values for calcium and phosphorus in colostrum and intermediate milk are correlated with higher percentage of proteins in this milk.

297. Studies on human milk collected from Calcutta and its Suburbs—Part I.

C. MAJUMDAR, AMALA CHAUDHURI, SACHINDRA K. CHAKRABORTI
and JAYANTI SEN GUPTA, Calcutta.

Since no complete data on the composition of human milk of Indian mothers are as yet available, a detailed chemical analysis of a total number of eighty-seven samples of human milk, collected from Calcutta and its suburbs, has been made on the following items: (1) specific gravity; (2) fat; (3) lactose; (4) total proteins; (5) albumins; (6) casein; (7) non-protein nitrogen; (8) calori output; (9) inorganic chloride; (10) inorganic phosphate; (11) total solid; (12) solid-not-fat; (13) ash; (14) sodium; (15) potassium; (16) calcium; (17) magnesium; and (18) ascorbic acid. The data, so far collected, were, more or less, in agreement with the data reported in the Western countries. The potassium concentration in the milk was low, and the optimum ratio of Potassium : Sodium for the normal growth of infants was not maintained in the milk studied by us. Ascorbic acid value was satisfactory.

Classification of the data, according to (a) age of the mother; (b) parity, and (c) lactation periods, showed that the age of the mother and parity had little influence upon the composition of milk.

There was no significant difference in the composition of mature milk and milk of late-lactation period. However, milk of transition period (11th day—30 days), and late-lactation period gave high values for fat. Some abnormal values in composition of milk were obtained in case of mothers with diseased children. The work is being continued.

298. Analysis of old samples of milk preserved with Formalin.

P. N. SENGUPTA, B. R. ROY and S. N. MITRA, Calcutta.

Analysis of old samples of milk preserved with formalin makes the correct estimation of the fat by the usual Gerber method sometimes troublesome because of the difficulty of pipetting representative sample in the butyrometer tube, dissolving the hardened casein in the acid without applying excess of heat and consequent charring.

To overcome these difficulties, the usual "maceration method" was followed for the estimation of fat and S.N.F., which gave reproducible results. In order to check the fat value obtained by maceration method both the Werner-Schmidt and Roese-Gottlieb methods were tried. It was found that Roese-Gottlieb method may at times give seriously low result in old samples. This may be due to incomplete separation of the fat by the rather milder treatment in this method. Werner-Schmidt method on the other hand gave accurate results comparable to maceration method. It could also be carried out much more quickly than the maceration process. An improved type of siphoning arrangement has been described by which the whole of the ether layer containing the fat can be siphoned off easily without disturbing in any way the lower acid layer.

299. Action of Crystalline Fungal Alpha Amylase on Starch and Starch Components.

DURLAV K. ROY, Calcutta.

In the present paper, action and rate of hydrolysis 2 p.c. solutions of potato starch, corn amylose, corn amylopectin, waxy maize starch and glycogen by crystalline alpha amylase were studied. Time of enzyme action as well as proportion of enzyme were varied. The extent of hydrolysis was followed up in terms of maltose formed from the substrates. With moderate (50 units per ml.) amylase concentration, 66·7 p.c. of potato starch, 79·8 p.c. of corn amylose, 57·1 p.c. of corn amylopectin, 55·6 p.c. of waxy maize starch and 36·2 p.c. of glycogen were broken down to maltose in 6 hours at 30°C. With very high concentration (500 units per ml.) of amylase the conversion figures were 90·9, 98·2, 86·4, 86·1 and 65·8 respectively. Rate of maltose formation from the substrates was very rapid upto

3 hours. In case of corn amylose the breakdown reaches completion but in cases of amylopectin, waxy maize starch and glycogen, the rate of maltose formation falls off and reaches almost a stationery phase after 6 hours. Corn amylopectin and waxy maize starch behave identically and it seems the residual 14 p.c. of these materials have linkages other than 1 :4. Glycogen seems to have 35 p.c. of residue which is not vulnerable to the action of alpha amylase. Formation of other reducing sugars are not ruled out.

300. Further studies on the Standards of Ghee in Hilly Areas of Darjeeling.

SATYA RANJAN SARKER, Darjeeling.

Forty different samples of pure ghee collected from four different sources, ten samples from each source were analysed for BRR at 40°C, Reichert Wollney, Polenske, Kirshner and Acid values respectively. The BRR of all the samples are on the increasing side. This may be fixed as 40·0 to 44·0. Reichert Wollney values in general show figures less than 28, which may reasonably be fixed as "not less than 24". The Polenske values may be fixed as 1·5 to 2·9 and Kirhsner value as 20 0 to 25·0. Acid values of the above samples showed average figures of 1·5, 1·6, 1·8 and 1·7 respectively. Thus the prescribed standard of 3·0 is rather high. It may be fixed as "not more than 2·5% as Oleic Acid".

301. Enzymatic synthesis of Starch in Rice Grain.

M. KANTHARAJ URS and H. S. R. DESIKACHAR, Mysore.

Experimental evidence has been obtained for the existence in rise, of enzymes concerned with the synthesis of starch from glucose, through the phosphorylative pathway,

$$\begin{tikzcd}
\text{Glucose} \arrow[r, leftrightharpoons, "\text{Hexokinase}"] & \text{G-6-Phosphate} \arrow[r, leftrightharpoons, "\text{Phosphoglucomutase}"] & \text{G-1-Phosphate} \arrow[r, leftrightharpoons, "\text{Phosphorylase}"] & \text{amylase} \arrow[d, "\text{Q-Enzyme}"] \\
 & & & \text{amylopectin}
\end{tikzcd}$$

Methods for the purification and assay of the enzymes are described.

302. Studies on Lipid Metabolism : (II) Effect of high protein diets on the development of experimental Atherosclerosis and the role played by Glucose-cyclo-acetoacetate.

M. C. NATH and A. SAIKIA, Nagpur.

The feeding experiments of high protein diets containing defatted egg albumin, casein and meat at 40% level were performed on rats for a period of 15 weeks.

On feeding these high protein diets, hypercholesteremia has been developed in the plasma and tissues, resulting to elevated C/P ratio, the liver fat and Iodine Values have been decreased and the tissue phospholipid lowered. The methionine content of the liver of the animals has been decreased.

Hydrolysed glucose-cyclo-acetoacetate (GCA) while injected to the animals fed high protein diets has been found to show lower C/P ratio and practically normal levels of cholesterol and phospholipid in the plasma and tissues. Further, these groups have shown increased levels of liver methionine and liver fat with better growth of the animals than those of the animals fed high protein diets only.

It has been shown that prolonged feedings of high protein diets at 40% level caused gradual development of hypercholesteremia and atherosclerosis which could be checked by the administration of hydrolysed GCA.

303. Standards of purity and Adulterants of Mustard Oil in Darjeeling.

SATYA RANJAN SARKAR, Darjeeling.

Six hundred samples of Mustard Oil received from the whole district of Darjeeling were analysed to assess the purity in the light of the prescribed standards by Government of India. Butyro-refractometer reading at 40°C, Saponification value and Iodine value estimated as per standard methods. Argemone oil and mineral oil was absent in all samples. Mainly the adulterants were linseed oil, sesame oil and ground nut oil. Total percentage of adulteration was 9·1. Among the adulterants 72·7% was with linseed oil, 20·0% with sesame oil and rest 7·3% with groundnut oil.

304. Nutritive value of canned Prawns.

P. L. SAWANT and N. G. MAGAR, Bombay.

Prawns canned in 2·5% brine, after 5 minutes blanching of the cleaned product and steam exhaustion, were analysed for the various nutrients present. It was found that canned prawns compared well with the fresh sample in their moisture, proteins, N.P.N., iron, calcium, phosphorus contents. While riboflavin and niacin were present in fair amount, thiamine was present only in traces. As regards amino acids lysine, leucine and arginine were present in appreciable amount than the other amino acids. Only traces of tryptophane were, however, found in canned prawns.

305. Studies on the nutritive value of Tribal Alcoholic Beverages.

P. N. SEN GUPTA, Calcutta.

The beer-like homely brewed beverages, prepared from varieties of cereals and millets by different tribes, play a very important role in the daily life, culture and nutrition of the people living in the tribal areas of western, central and eastern India and in N.E.F.A. The importance of their drinks was realised at the time of carrying out dietary surveys among these tribes. It was later ascertained that these drinks were nutritionally important to them and were correcting to some extent their deficiencies of some of the dietary essentials. At the same time the distilled liquors had only intoxicating value and were harmful to these people many of whom were found to be malnourished. To assess the exact nutrients contents of these drinks, samples were collected from all these tribes and these were preserved with a preservative to arrest the fermentation. Special investigations were undertaken among the tribes of Orissa, Jhargram and Santal Parganas and samples were obtained from many tribes. All of these were analysed for nutritive values, calories, protein, mineral matters and B-vitamins. It was evident from the analysis of about 125 samples that all of these beer-like drinks were nutritionally important to the tribes and some were good, nutritious and refreshing drinks with low alcohol contents.

306. Chromatographic examination of acids in some wild fruits of Naini Tall—II.

D. R. GUPTA and S. C. GUPTA, Naini Tal.

In continuation of previous investigations, authors have examined non-volatile organic acids in the fruits of seven more wild plants which get ripen after September in Naini Tal.

Fruit juices were examined by descending technique of chromatography using *n*-butanol—formic acid—water (10 :2 :5) as solvent phase.

Ripe fruits of *Rhamnus virgata* Roxb. ("Chēdula") and *Sarcococca pruniformis* Lindl. ("Paliāla" or "Gēru") were found to contain gluconic and malic acids; *Asparagus curillus* Buch.-Ham. ("Kāirua" and *Rosa moschata* Mill. ("Kūnja") gluconic, citric and malic acids; *Stranvaesia glaucescens* Lindl. ("Gadh Mēhal") citric and malic acids; *Vitis semicordata* Wall. ("Lāderi") tartaric and malic acids; and *Rosa macrophylla* Lindl. ("Kūnja") gluconic, tartaric, citric and malic acids. Fruits of *Rosa macrophylla, Rosa moschata* and *Stranvaesia glucescens* were found to have one more acid in addition to the above mentioned acids. This unidentified acid has got 0·19 R_f value and its spot appears in between the spots of gluconic and oxalic acids.

307. Chemical examination of the fruit contents of Cassia fistula (Linn.).

V. G. SONAR and V. A. PATWARDHAN, Sangli.

Cassia fistula (Linn.), known in Marathi as 'Bahava' belongs to the botanical family of Leguminosae. The black pulp along with the septa, obtained from the fruits or pods of the tree, being of some medicinal value, was analysed according to the A.O.A.C. methods and the following results were obtained :—Moisture 18·4%, Ash or Mineral 4·2%, Crude protein 3·4%, Crude fibre 22·4% and digestible carbohydrates 51·6%.

The percentages of free sugars and starch were found out to be 60·3 and 9·9 respectively. The percentage of sand and siliceous matter in the ash was found to be 18·9 i.e. 0·95% in the original matter. The analysis of the ash showed the presence of Iron, Magnesium, Phosphate, Carbonate, Sulphate and silica (greater proportions) and Sodium, Potassium, Calcium and Chloride (smaller proportions).

Chromatographic analysis of the free sugars indicated mainly the presence of Glucose and Xylose. The pulp along with the septa was analysed chromatographically for its amino-acid contents and the following amino-acids were found to be present, but in smaller proportions :—Leucine, Phenylalanine, Valine, Tyrosine, Proline, Alanine, Glutamic acid, Serine, Arginine and Histidine. The pulp is hygroscopic, sweet to taste and soluble in water.

308. Chromatographic examination of sugars in some wild fruits of Naini Tal—II.

S. C. GUPTA and D. R. GUPTA, Naini Tal.

Authors have previously examined several fruits of wild plants of this area for the presence of sugars. In the present study fruits of seven more wild plants, which get ripen after September, were examined for sugars with the help of descending paper chromatography. *n*-butanol—acetic acid—water (4 :1 :5) was used as solvent phase and benzidine reagent (0·5 gm. benzidine, 10 ml. acetic acid, 10 ml. 45% trichloroacetic acid and 100 ml. 95% ethanol) was used for the detection of spots. Though Rf values of eight sugars were estimated but sugars were also spotted along with the fruit juices to avoid any error due to changes in room temperature.

Glucose and fructose were found to be present in the ripe fruits of *Asparagus curillus* Buch-.Ham. ("Kāirua"); maltose, glucose and fructose in the ripe fruits of *Rhamnus virgata* Roxb. ("Chēdula"); and sucrose, glucose and fructose in the ripe fruits of *Rosa moschata* Mill. ("Kūnja"), *Sarcococca pruniformis* Lindl. ("Paliāla" or "Gēru"), *Stranvaesia glaucescens* Lindl. ("Gadh Mēhal") and *Vitis semicordata* Wall. ("Lāderi"). In *Rosa macrophylla* Lindl., in addition to sucrose, glucose and fructose, one pentose (R_f value 0·3) was also found to be present which might be xylose.

309. Inhibitory Effect of L-lysine on Penicillin Biosynthesis by P. chrysoqenum in both Synthetic and Commercial Fermentation Media.

D. GHOSH and P. S. BORKER, Pimpri.

The effect of L-lysine on penicillin biosynthesis has been studied in shake flask penicillin fermentation using both synthetic and commercial fermentation media. Penicillin formation is inhibited as much as about 75 per cent with $2{\cdot}74 \times 10^{-2}$ M concentration of L-lysine. The possible mechanism of inhibition of penicillin biosynthesis by L-lysine is discussed.

310. A study of the Lipids of Streptomyces olivaceus.

P. K. MAITRA, RAJ SUDHIR MITRA and S. C. ROY, Calcutta.

Lipids from the mycelia of *Streptomyces olivaceus* harvested from a complex medium on the third day of growth, and constituting a little more than 6% of the dry weight of the cells, was separated into phospholipid and glyceride fractions by solvent fractionation and precipitation techniques. The phospholipid fraction was resolved into a cephalin and a lecithin part each of which in addition to the respective nitrogenous bases, contained as many as four amino acids, histidine being common to both. The glyceride fraction was characterized by a high saponification value (242), low iodine value (39) and a comparatively higher percentage of free fatty acids (10% of the total glyceride expressed as oleic). The glyceride fraction contained myristic acid as the predominant fatty acid. No cholesterol could be detected. Manometric studies with resting cells had indicated that *S. olivaceus* oxidize a number of fatty acids, palmitic and myristic acids being the more active substrates.

311. Enzymatic oxidation of uridinediphosphateglucose by Mung bean seedling extract.

N. C. GANGULI, Calcutta.

An enzyme preparation from mung bean seedling (5 day old) was found to oxidize uridinediphosphateglucose in the presence of diphosphopyridine nucleotide. This oxidation was appreciably stimulated in presence of cystenine and Mg++ ion in the system. PCMB and EDTA were found to inhibit this system. Uridinediphosphateglucuronic acid was isolated and characterised to be the reaction product. No trace of uridinediphosphategalacturonic acid was formed when uridinediphosphateglucose was used as substrate. Using radioactive uridinediphosphateglucose labeled with C^{14} in glucose moiety, uridinediphosphateglucuronic acid labeled with C^{14} in glucuronic acid moiety was prepared. This enzyme preparation was also found to oxidize uridinediphosphategalactose in the presence of diphosphospyridine nucleotide. The oxidation rate is much slower in comparison with uridinediphosphateglucose. The possibility of the oxidation of uridinediphosphategalactose was discussed.

312. A new method for purification of beef fibrinogen.

N. R. KALE, Poona.

Oxalated, deprothrombinised beef plasma is fractionated with the use of methyl cellosolve (ethylene glycol monomethyl ether) as a fractionating agents. A crude precipitate of fibrinogen thus obtained is further fractionated under similar conditions to obtain 80-84% coagulable product. Taking the advantage of low solubility of fibrinogen in presence of glycine-ctrate buffer system containing methyl cellosolve, a product having 93-95% coagulable protein is isolated. Further purification is achieved by precipitating insoluble globulins at low ionic strength in glycine-citrate buffer system containing methyl cellosolve. The final product obtained is 97-98% coagulable and the yield is as high as 40-45% of the fibrinogen present in the original plasma. Purified fibrinogen is readily soluable and stable both in a lyophilized condition and sodium chloride solution.

Purified product is demonstrably free from prothrombin, antihaemophilic globulin, plasmin and most probably from plasminogen. Electrophoretic and ultracentrifugal studies of purified fibrinogen indicate that it is essentially a homogeneous protein. Application of this method with slight modification to human plasma yields 97-98% coagulable protein. Purity of the fibrinogen preparation obtained by the above procedure, as judged by the characteristic high specificity of thrombin in transforming it to insoluble fibrin, indicates that at least 97% of the molecules are identical and other physicochemical data obtained is commensurate with this interpretation.

313. Studies on Mahua Sterol from Bassia Latifolia.

P. N. BHARGAVA and R. P. SINGH, Banaras.

Mahua sterol has been obtained from Bassia latifolia and purified by chromatographic and fractional crystallisation methods. It has been found to contain one hydroxyl group and has β-configration. Its properties have been studied and various derivatives prepared.

314. Preservation of Neera with 'Paludrine'.

P. S. SARMA, Madras.

The long felt need for an effective and better preservative instead of lime for Neera, the sweet toddy juice from palm trees has been met by an elegant and simple method developed in this department using small mounts of 'Paludrine' as the preservative. 'Paludrine', a cheap antimalarial compound has been found to preserve Neera for over 48 hours, when added at a concentration of 100 mgm., per pound of Neera. Further, 'Paludrine' can be completely removed from Neera so preserved by passing the same through a bed of activated paddy husk charcoal just before using it as a drink or just before conversion to palm gur or palm sugar. The palm gur thus prepared is better in quality, taste and smell, compared to that prepared from Neera preserved with lime. Also, the process of crystallisation to palm sugar is quicker and does not involve the tedious superphosphate treatment now practised for deliming Neera which has been preserved with lime.

A simple colour test with Sodium hypochlorite can be used to find out whether Paludrine has been added to the pots as a preservative and also for observing whether 'Paludrine' has been completely removed from Neera, when passed through activated paddy husk charcoal.

315. Inhibition of oxidation of Ascorbic Acid by EDTA.

M. V. L. RAO, L. V. L. SASTRY, M. SRINIVASAN and V. SUBRAHMANYAN,
Mysore.

Attempting to stabilise ascorbic acid solutions for certain studies, use was made of ethylenediamine tetracetic acid (EDTA)—a well known metal complexing agent—to prevent the copper-catalysed aerobic oxidation of the vitamin which is mainly responsible for its rapid deterioration in aqueous solution. At low concentrations (0.2-2.0 mM) the chelating agent helped to preserve the vitamin solutions for at least 24 hrs, but, unexpectedly, at higher concentrations it exerted a pro-oxidant effect. This anamolous behaviour led to a detailed investigation of the inhibition of the oxidation of ascorbic acid by EDTA. Finally, it was found that adequate acidification of the solutions (to pH 3 or below) counteracted the deleterious effects of excess EDTA and enabled it to afford full protection to the vitamin so that even dilute solutions could be stored at room temperature for over two weeks without any loss in strength and without recourse to the customary stringent conditions such as the use of triple glass-distilled water, inert atmosphere etc. Furthermore, under optimal conditions, solutions of ascorbic acid containing EDTA could be subjected to heat treatment with impunity and even evaporated to dryness over the water bath with 100% recovery. The results of the experimental studies and the possible practical applications of the findings will be discussed.

316. Studies on the stability of Vitamin C in aqueous solutions. I. The rate of decomposition at high dilution with or without added copper.

J. DUTTA, R. B. MUKHERJEE and C. R. RAHA, Bose Institute, Calcutta.

Solutions of vitamin C were prepared in copper-free all-glass distilled water. In another batch of the vitamin solutions 10^{6} gm ml. copper was added in the form of copper sulphate. The different solutions were then studied with a Beckman DU spectrophotometer at 265 mμ. It was found that the plot of optical density against time (in seconds) in each case was a straight line. The pH values of the solutions were also found to increase from 3.8 to nearly 5.0 in all cases. But on keeping for 24 hours the pH values decreased to 3·6 to 3·8 again. Ratio of the rates of decomposition of vitamin C with and without copper suggested that copper was a positive catalyst for the decomposition of vitamin C. The nature of the curves and the fact that the pH values increased with time during the measurement showed that the rates that were measured must be of one of the first two steps as shown in the following :

Step I : Ascorbic acid$\rightarrow O_2$ Dehydroascorbic acid.

Step II : Dehydroascorbic acid$\rightarrow$Diketogulonic acid

Step III : Diketogulonic acid$\rightarrow$Threonic acid.

Step IV : Threonic acid$\rightarrow$Oxalic acid.

The third and fourth steps should have decreased the pH which was observed after 24 hours in the present investigation.

The linearity of the curves also suggests that the reaction is of the first order, so most probably the reaction rates which have been measured was of the 2nd step, i.e., Dehydroascorbic acid—Diketogulonic acid.

317. Comparative Studies of Adsorptive Capacities of Alumina Oxide Powder in Enzyme Chromatography.

M. M. BISWAS, Calcutta.

Activated alumina I was prepared by treating 50 gms aluminium sulphate in 150 c.c. distilled water with 500 c.c. 15% ammonia at 55°C. The precipitate after proper treatment was dried in the steam oven, powdered and activated by heating in a closed crucible made of stainless steel. Alumina II and III were prepared from aluminium hydroxide B.D.H. and Brockmann's alumina in a parallel way. An yeast extract was prepared by autolysing brewer's yeast with toluol and distilled water and then filtering with kieselghur under suction. A 2% solution of this product was prepared and 25 c.c. filtered through a 5 c.m. column of 3 parts activated alumina I & 1 part quartz powder in a 10 c.m. × 2 c.m. chromatographic tube. Absorbed enzymes were eluted from the column by treatment with N/10 ammonia. Activities of filtrate and eluate were tested. Experiments were repeated with alumina II & III. Ratios of saccharase activities of filtrate and eluate for alumina I, II & III were found to be 0.69, 0.86 and 1.03 indicating that saccharase activities of chromatographic filtrate and eluate vary with the three samples of activated alumina and that Brockmann's alumina yields the maximum activity in the filtrate.

318. Determination of "Bound" Formaldehyde in Formaldehyde-Peptone mixtures.

V. SUBBA RAO, Waltair.

Peptones from two different manufacturers were exposed to moist formaldehyde vapour in desiccator and latter dried under reduced pressure to constant weight. The formol titration values indicated that some formaldehyde was absorbed by peptone. The formol titration values of these solutions on storage were found to increase indicating that some of the formaldehyde absorbed was liberated during storage.

The formaldehyde contents of these solutions were determined by the chromatropic acid method after Vorlander's reaction and they were found to decrease on storage. The formaldehyde contents of the solutions on storage as determined by the formyl titration method were found to vary from 35·1 to 26·4 mg. per g. of peptone A and from 33·3 to 22·2 mg. per g. of peptone B. The formaldehyde content of the same solutions determined by the chromotropic acid method after Vorländer's reaction were found to vary from 28·7 to 19·4 mg. per g. of peptone A. and from 27·7 to 20·1 mg. per g. of peptone B. From this study it appeared that some of the formaldehyde absorbed by the peptones was "reversibly bound" and became reversible or liberated in solution during storage.

319. Mode of Action of Cobra-Venom (Naja Naja) in the coagulation process of Blood.

S. P. SINHA, Calcutta.

Cobra Venom does not possess clot promoting activity. In higher concentrations it is capable of denaturing the proteins of the plasma and thus shows an inhibitory action in the coagulation process. The proteolytic activity increases with the concentration of the Venom and can ultimately ensure no clotting.

The inhibitory action of the venom depends upon its concentration as also upon the concentration of Prothrombin present in plasma. The amount of venom which can completely inhibit coagulation of rabbit, Guineapig plasma is not effective in the case of same quantity of human or ox-Plasma, where only a delayed clotting is observed.

320. The effect of the degree of polishing of Rice on Nitrogen and Mineral Metabolism in Human spbjects.

G. RAMA RAO, H. S. R. DESIKACHAR and V. SUBRAHMANYAN, Mysore.

Nitrogen, calcium and phosphorus balances were studied in human subjects fed a rice diet in which the rice had been polished to 0·0, 2·9, 4·1 and 6·3% respectively. The husked and 2·9% polished rice produced negative calcium balances in the subjects. 6·3% polished rice produced best nitrogen and calcium balances but contained only 1·1 γ/g of thiamine. 4·1% polished rice represented a *via media* stage of polishing with a reasonable thiamine content and could be recommended for consumption by rice eaters. It did not produce negative balances of calcium as observed in samples with a lower degree of polishing.

The possible harmful effects of completely unpolished rice in diets with low calcium content and the need for calcium fortification of such diets is discussed.

321. Serological behaviour of sensitive parent and penicillin resistant variant of a strain of Micrococcus pyogenes var aureus.

B. C. DUTTA and S. K. BOSE, Calcutta.

(1) The behaviour of sensitive parent and penicillin resistant variant (isolated at a level of 8000 u/ml.) of a strain of *Micrococcus pyogenes var aureus* was studied to indicate the difference in their serological reactions.

(2) Antigenically the intact cell, cell-wall and cell-free extract of the sensitive parent appear not to differ appreciably whereas those of the resistant variant do differ considerably in their specificities.

(3) The serological behaviour of intact cell, cell-wall and cell-free extract of the resistant variant differs markedly from the serological behaviour of those of the sensitive parent respectively.

(4) Resistant variant seems to be highly antigenic and leads to the production of high titre serum which may prove useful in treating cases of infection by penicillin resistant organisms.

322. Effect of Heated Tetanus Toxin, Strychnine, Picrotoxin and Cortisone on the Glutamine Synthetase and Glutamotransferase Activity of Rat Brain.

S. R. GUHA, H. S. CHAKRAVARTI and J. J. GHOSH, Calcutta.

Glutamic acid-glutamine system plays an important part in the ammonia-removal and ammonia-forming mechanism in brain. It has been shown that heated tetanus toxin, strychynine or picrotoxin produces an appreciable inhibition (35 to 50%) of glutamine synthetase activity whereas the glutamotransferase activity remain unaffected. Cortisone, on the other hand, showed no effect on either of the enzyme systems studied. The inhibition of the glutamine synthesis by strychnine, pictrotoxin or heated tetanus toxin offers some explanations for their ammoniagenic effects, observed under both *in vitro* and *in vivo* conditions.

323. Carbon dioxide Assimilation by Leishmania donovani, the Causative Organism for Kala-azar.

ANADI N. CHATTERJI and JAGAT J. GHOSH, Calcutta.

Cell suspensions of *L. donovani*, under anaerobic conditions, can metabolize glucose very rapidly into different acids, both volatile and non-volatile. The anaerobic utilization of glucose is also accompanied by the assimiliation of carbon dioxide, which has been measured from the carbon dioxide balance studies, done manometrically using bicarbonate buffer and N_2-CO_2 (95 :5) as gas phase. It has been observed that for 1 mole of the glucose utilized 1·8 moles of acid are formed and 0·3 to 0·4 moles of CO_2 are fixed. Preliminary studies indicate that the major portion of non-volatile acids formed belong to the C_4-dicarboxylic acid group. It is probable that the carbon dioxide fixation plays an important part in the formation of these dicarboxylic acids by *L. donovani.*

324. Some observations on the metabolism of C^{14} compounds in human malignant tissue.

S. C. ROY, S. B. ROY and D. BHATTACHARYA, Calcutta.

In vitro incorporation of C^{14} from acetate-1-C^{14}, acetate-2-C^{14} and pyruvate-1-C^{14} by the human malignant and analogous normal tissues had been studied in different fractions obtained chemically and further separated chromatographically where necessary into different constituents. They were (a) respiratory carbondioxide, (b) lipids—cholesterol and its ester, phospholipids (lecithin, cephalin) and triglycerides, (c) volatile compounds, (d) carbohydrate and some Krebs cycle intermediates, including α-keto acids etc., (e) free and protein amino acids.

With carboxyl labelled acetate (acetate-1-C^{14}) the lipid fraction, glucose and oxaloacetate in malignant tissue are more heavily incorporated with C^{14} than those in the normal, while respiratory carbondioxide and succinate in analogous normal tissue take up C^{14} more than the malignant. The case is reversed with acetate labelled in methyl carbon (acetate-2-C^{14}). With pyruvate-1-C^{14}, lipid fraction in normal and respiratory carbondioxide in malignant tissue is more heavily incorporated with C^{14}.

325. Study of the Ribose Metabolism in Cell-free Bacterial preparations.

R. B. MUKHERJEE and D. P. BURMA, Calcutta-9.

The methods employed for the rupture of bacterial cells include autolysis, alumina grinding, exposure to sonic and ultrasonic oscillations and shaking with glass beads in the Mechanical Cell Disintegrator.

Lactobacillus plantarum grown on glucose was chosen for the study of ribose metabolism as Horecker and co-workers (J. Biol. Chem. *231*, 1009, 1958) have demonstrated the presence of phosphoketolase even in glucose-grown cells. The first step in the assimilation of ribose was phosphorylation by adenosine triphosphate, as shown by the formation of adenosine diphosphate. The latter was assayed by muscle phosphoenolpyruvate kinase and lactic dehydrogenase. The next step in the chain of reactions i.e., the isomerisation of ribose-5-phosphate was catalysed by another constitutive enzyme phosphoriboisomerase. Conversion of ribulose-5-phosphate, the product of isomerisation, to xylulose-5-phosphate was shown by measuring the acetyl phosphate formed from ribose-5-phosphate added to the extract which had phosphoketolase activity as well. The last step, which is an energy-yielding reaction was the conversion of acetyl phosphate to acetate and adenosine tri-phosphate, catalysed by the enzyme acetokinase. All the enzymes involved in ribose metabolism are thus found to be constitutive.

326. Bibulose Diphosphatase and its role in the Photosynthetic Cycle.

(MISS) M. CHAKRAVORTY, H. C. CHAKRABORTTY and D. P. BURMA, Calcutta.

Two steps in the photosynthetic cycle (reductive pentose phosphate pathway) involve removal of the C-1 phosphate from a diphosphate, fructose diphosphate (FDP) in one case and sedoheptulose diphosphate in the other. A C-1 diphosphatase which reacts with both ribulosediphospate (RuDP) and FDP at the same rate has been purified about 17 fold starting from acetone powder of *Spinacia oleracea.* The affinity of the enzyme for the two substrates was found to be the same. From the same ratio of activities with the two substrates at different stages of purification and from competitive inhibition experiments it is obvious that one enzyme is involved in the two reactions. This is an acid diphosphatase as it displayed maximum activity at pH 5·5.

With the isolation of this C-1 diphosphatase it is tempting to speculate that the enzyme plays a dual role in the photosynthetic cycle. During photosynthesis fructose diphosphatase must be active to keep the photosynthetic cycle in operation by generating hexose monophate from FDP, the latter being formed by the reduction of phosphoglyceric acid and subsequent reverse aldolase activity. At low carbon dioxide tension as well as in absence of light for a while after active photosynthesis RuDP starts accummulating. To reduce the size of this pool-ribulose diphosphatase converts RuDP to ribulose monophosphate and thus tend to reverse at least one of the major ATP-dependent steps of the photosynthetic cycle i.e., the phosphorylation of ribulose-5-phosphate.

327. Enzymatic evidence of the occurrence of the Pentose Phosphate pathway in the germinating Mung Bean seedling.

(MISS) M. CHAKRAVORTY and D. P. BURMA, Calcutta

The occurrence of the direct oxidate pathway in the germinating mung bean seedling has been demonstrated by showing the presence of the enzymes of the pentose phosphate cycle. The presence of both glucose-6-phosphate (G-6-P) dehydrogenase and 6-phosphogluconate (6-PG) dehydrogenase has been detected by measuring the reduction of triphosphopyridine nucleotide (TPN). The presence of phosphoriboisomerase (PRI), the next enzyme in the cycle was shown by the cysteine carbozole colour reaction of ribulose-5-phosphate formed from ribose-5-phosphate (R-5-P). The presence of phosphoketopentoepimerase (3-epimerase) could not be directly demonstrated due to want of xylulose-5-phosphate (Xu-5-P) but its presence was indicated by the transketolase activity of the seedling-extract. The isomerase was isolated from acetone powder of *Spinacia oleracea* and purified 60 fold. Ga-3-P formed was estimated by the addition of excess of muscle phosphotriose isomerase and glycerophosphate dehydrogenase and measuring the oxidation of reduced diphosphopyridine nucleotide. The addition of seldoheptulose-7-phosphate and Ga-3-P (generated in the system from fructose diphosphate and muscle aldolase) to the seedling extract resulted in the formation of fructose-6-phosphate (F-6-P) indicating the presence of transaldolase. F-6-P was measured by its conversion to glucose-6-phosphate (G-6-P) by muscle phosphoexose isomerase and its subsequent oxidation by yeast G-6-P dehydrogenase and simultaneous reduction of TPN. The last enzyme phosphohexose isomerase which completes the cycle is also present in the extract, as shown by the formation of F-6-P from G-6-P, measured by both chemical and enzymatic methods.

328. Factors involved in the synthesis of Ascorbic Acid by Rat Liver Microsomes.

I. B. CHATTERJEE and N. C. GHOSH, Calcutta.

It has been reported that rat liver microsomes (Science & Culture, *23*, 382, (1958)) on incubation with D-glucuronolactone in the presence of potassium cyanide (0·05M) and without co-factors shows a marked synthesis of ascorbic acid, no appreciable synthesis being observed with 0·005M or lower concentration of cyanide. The present paper reveals that synthesis of ascorbic acid takes place also in the presence of low cyanide concentration (0·005M), if a metal binding agent such as sodium pyrophosphate, α-α'-dipyridyl, 8-hydroxyquinoline or reduced glutathione is added to the system. DPNH helps in the synthesis which is further augmented with the addition of ATP. ATP by itself, has got no influence in the conversion.

329. In vitro synthesis of Ascorbic Acid by the Liver Microsomes of normal and carbon tetrachloride treated non-chloretonised rats.

G. C. CHATTERJEE and N. C. GHOSH, Calcutta.

The injection of carbontetrachloride to rats in doses 0·03 c.c./100 gm. body wt., damages the liver microsomes so far as the *in vitro* synthesis of ascorbic acid from D-glucuronolactone in presence of cyanide is concerned.

330. Biopotency of crystalline all-trans retinene$_2$ (vitamin A$_2$-aldehyde).

H. R. CAMA and P. R. SUNDARESAN, Bangalore.

Following the interesting observation that some species of Indian freshwater fish liver-oils contains the highest amounts of vitamin A$_2$ hitherto reported in literature (Balasundaram et al., Biochem. J., 1956, *64*, 150), retinene$_2$ was obtained in a crystalline form from rich vitamin A$_2$ oil and its biological activity was compared with that of crystalline vitamin A acetate. The spectroscopic characteristics of crystalline retinene$_2$ were identical with those reported earlier (Cama et al., Biochem. J., 1952, *52*, 535). Maleic anhydride adduct formation on vitamin A$_2$ alcohol, obtained by reduction of retinene$_2$ with lithium aluminium hydride, showed that it was entirely *all-trans*.

The biopotency of crystalline *all-trans* retinene$_2$ was carried out using the Latin-squre design in the U.S.P. growth-test. Retinene$_2$ was fed at two levels of 1·79 and 3·58 ug. as against 2·06 and 4·12 i.u. of the international standard of crystalline vitamin A acetate. Statistical analysis showed that crystalline *all-trans* retinene$_2$ has a biological activity of 47% compared to vitamin A acetate. By analogy to retinene$_1$ and vitamin A$_1$, the biopotency of retinene$_2$, *vis-a-vis* vitamin A$_2$, is almost equal to that of β-carotene.

331. Preliminary examination of the Anti-Bacterial principle(-s) in Palm Gur.

M. R. JOSHI and KAMALA SOHONIE, Bombay.

Bhagwat and Sohonie,[1] from the paper chromatographic evidence and the chemical colour tests,[2] have reported the presence of isoniazid (INH)-like substances in 15% samples of Neera, which they have examined. Since Neera is a raw meterial from which Palm Gur is prepared, the present investigation was undertaken with a view to examine whether Palm Gur too contains INH-like substances. The investigation was further extended to examine whether Palm Gur contains any anti-bacterial principle(-s) in general, which may be responsible for the traditional administration of Palm gur in the treatment of certain human diseases. The Palmyrah variety (Borassus Flabelliformis) of Palm gur was used throughout the investigation.

The investigation consisted of preparing a 'crude Palm gur extract', examining some of its properties and studying its anti-bacterial action against a variety of gram positive and gram negative microorganisms. The results obtained indicate that similar to Neera, Palm gur also contains INH-like substances. The further examination of Palm gur indicates that it contains some unidentified anti-bacterial principle(-s).

332. Studies in the nutritive value of double bean (Faba Vulgaris M.).

A. N. INAMDAR and KAMALA SOHONIE, Bombay.

Proximate analysis of Double Bean flour revealed that the protein content is high up to the extent of 22%. The action of Pepsin and Trypsin on the raw and autoclaved flour was studied to understand the invitro digestibility. Tryptic hydrolysis was inhibited in the case of raw flour. Biological experiments on weaning albino rats were carried out to study the growth effects of raw and autoclaved flour. The effect of essential amino acid supplementation to the raw and autoclaved Double Bean diets was also studied.

333. Proteins of Double Bean.

KUNJLATA KOTHARY and KAMALA SOHONIE, Bombay.

The study was undertaken with a view to isolate the proteins from Double Bean flour. Fractionation of the aqueous extract was done with different concentrations of ammonium sulphate. The preparations so obtained, were analysed for their proximate principles. 'In-vitro' digestibility of these protein preparations was studied, and finally, complete Van-Slyke analysis was carried out to know their chemical composition.

334. The proteins of field Bean (Dolichos Lab-Lab).

S. R. DHONDE and KAMALA SOHONIE, Bombay.

The field-bean meal was extracted with 3% Sodium Chloride solution. The proteins were fractionated from this extract with ammonium sulphate at 35%, 50% 75% and 100% satutations.

These fractions were analysed for the proximate principles and also subjected for Van-Slyke analysis.

335. Growth Hormone and R.Q. : The Activity in vitro of Growth Hormone in Reducing the Respiratory Quotient of Rat Diaphragm.

P. R. DASGUPTA, Calcutta.

The effect on the Respiratory Quotient of isolated normal rat diaphragm respiring in glucose medium of the *in vitro* addition of : (i) ox hypophyseal growth hormone, (ii) a crude sterile alkaline extract of ox anterior pituitary tissue (Young 1953), a preparation rich in growth hormone and containing other anterior pituitary factors, and (iii) two fractions of the above alkaline extract was studied.

No relationship was found between growth promoting activity in the hypophysectomized rat and R.Q. depressing ability *in vitro*. One of the to factors of the alkaline extract was active in reducing the R.Q. *in vitro* although it was deficient in growth promoting activity. The R.Q. depressing factor appears not to be growth hormone in agreement with the conclusions of Recant.

APPLIED AND INDUSTRIAL CHEMISTRY

336. A simple Versatile Electronic Relay for Temperature Control.

S. RAMASWAMY and C. L. RAO, Trombay.

A simple and reliable electronic relay working on 230V 50 cycles, for the temperature control of thermostatic baths over a fairly wide range of temperatures, room temperature (about 30°C)—150°C is described. The circuit employs a thyratron tube. The maintenance of temperature is ±0·005°C on the lower range 30°C-50°C and ±0·2° on the higher range, 100°C-150°C.

337. Polymerisation of Safflower Oil.

Y. K. PURANDARE and K. K. DOLE, Poona.

Safflower oil is a good drying oil (I.V. = 145·0) and was subjected to heat-polymerisation in order to improve its film properties. Heat-polymerisation of the raw oil was carried out at four different temperatures, viz., 200°C., 250°C., 280°C. and 300°C. for twelve hours and the rate of polymerisation was studied.

The rate and the extent of polymerisation is especially very high at 300°C. because the oil-sample obtained after heating for 12 hours at that temperature shows a high molecular weight (1986) and a high acid value (16·10). The oil is very viscous (viscosity = 290 poises) and shows increment in the refractive index (1·4820). The iodine value also drops considerably.

Solvent fractionation of partially polymerised oil was also carried out. The various polymerised oil samples were used for the preparation of varnishes. The polymerised oils as well as the varnishes were tested for their various film properties such as drying-time, resistance towards alkali, solvent and water and after-tack, and it was found that the film properties were improved.

338. An Easy Method of Separation of the Major Fatty Acids of Karla Seed Oil.

V. A. SARAF and K. K. DOLE, Poona.

The fatty acid composition of Karla Seed Oil (Momordica Charantia Linn) is 46·7 per cent α-eleostearic acid, 29·8 per cent stearic acid and the remainder oleic and linoleic acids. The percentage of stearic acid being substantial, it is separated by crystallisation of the mixed fatty acids from acetone and alcohol. Stearic acid is insoluble in acetone at low temperatures and crystallises out. The unsaturated acids remain in the solvent and are obtained by recovering the solvent and removing the last traces. Thus the unsaturated portion of the fatty acids is enriched.

Experiments to utilise the enriched unsaturated portion in the preparation of alkyds are in progress.

339. Isomerisation of Safflower Oil with Iodic Acid.

Y. K. PURANDARE and K. K. DOLE, Poona.

Varying percentages of iodic acid at various temperatures were tried to isomerise safflower oil and it was found that iodic acid is a very powerful catalyst for bringing about isomerisation in safflower oil.

The high catalytic activity of iodic acid is perhaps due to I_2O_5 which is a decomposition product of iodic acid at high temperature.

The extent of isomerisation produced in safflower oil by using free iodine as a catalyst is less than the extent of isomerisation produced by HIO_3. Therefore it can be said that I_2O_5 is more active in shifting the double bonds from isolated to conjugated position than free iodine.

The oil samples isomerised with iodic acid show improvement in their film properties and dry faster than the raw oil.

340. Isomerisation of Safflower Oil.

K. K. DOLE and Y. K. PRANDARE, Poona.

Safflower oil is a good drying oil (I.V. = 145) and contains 64·6% linoleic acid as its main constituent. It was isomerised by using different catalysts under different conditions.

Of the various catalysts used, free iodine, iodic acid, hydriodic acid, Nickel-carbon and Sodium hydroxide were found to bring about a substantial isomerisation in safflower oil.

The various isomerised oil samples were tested for drying time and other film properties like resistance towards water, solvent and alkali and it was found that the samples showed improvement in these properties. Varnishes of these isomerised samples are being prepared and their properties are being studied.

341. Compositions of Oils by Urea Fractionation Method.

T. N. MEHTA and S. B. DABHADE, Nagpur.

The adoption of urea-complex formation for resolution of fatty components has been attempted with different methods arrived at in our laboratory. The compositions arrived at by the urea methods compared fairly well with those obtained by altogether different methods. For illustration, mixed fatty acids of sesame and safflower oil and their methyl esters have been fractionated by eluting urea adduct of total acids by alcohol. It is found that the separation in this procedure is similar to that of classical and displacement chromatography with urea as an adsorbent.

Fractionation data has been obtained by varying the amounts of urea and keeping the concentration of mixed fatty acids in methanol the same. The data obtained can be utilized for determining the rough composition of the mixed fatty acids as well as for fractionating mixed fatty acids into desired fractions.

The advantages of urea procedure have been discussed in light of other fractionation procedures.

342. Copper Plating from the Sulphamate Bath.

S. VENKATACHALAM and T. L. RAMA CHAR, Bangalore.

The electrodeposition of copper from copper sulphamate solutions has been investigated. The effect of the following variables on plating characteristics was studied : Electrolyte concentration, pH, temperature, agitation and addition agents. The optimum operating conditions for satisfactory deposition have been established. Mirror bright plates were obtained with some additions to the bath.

343. Corrosion Inhibition of Aluminium in Alkaline Solutions : Corrosion Potentials.

J. SUNDARARAJAN and T. L. RAMA CHAR, Bangalore.

The potentials of aluminium in sodium hydroxide have been measured with and without dextrin inhibitor under different conditions. The dissolution of the metal is electrochemical in character, and the adsorption mechanism for inhibitor action is indicated.

344. Electroplating of Iron Alloys from the Pyrophosphate Bath.

(MISS) VASANTA SREE and T. L. RAMA CHAR, Bangalore.

The complex pyrophosphate bath has been used for the codeposition of iron with nickel and zinc. The alloy plating was studied with reference to the effect of the common variables on deposition composition, cathode efficiency and cathode potentials. It was possible to obtain alloy deposits of iron-nickel and iron-zinc of any desired composition by a variation in the plating conditions. There were sudden jumps in the deposit composition and cathode potential in the low c.d. range during iron-zinc deposition. The constancy of composition with c.d. at higher c.ds. is a special feature of both the alloy plating processes.

345. Anodic Corrosion of Lead in the Pyrophosphate Plating Bath.

(MISS) VASANTA SREE and T. L. RAMA CHAR, Bangalore.

Optimum conditions have been established to promote normal dissolution and avoid passivity of the lead anode during the plating of the metal from complex pyrophosphate solutions. The factors which facilitate anode corrosion are : low anode c.d., higher free pyrophosphate content and pH of the solution and agitation. Under the proper conditions the efficiency of the anode was 100%, and weight loss measurements were in conformity with anode potentials.

346. Electrodeposition of Nickel-Zinc Alloys from the Pyrophosphate Bath; Electrode Potentials and Structure.

S. K. PANIKKAR and T. L. RAMA CHAR, Bangalore.

The effect of the variables on deposit composition, cathode efficiency and cathode potential was studied during the co-deposition of nickel with zinc from pyrophosphate solutions. There were sudden changes in the plate composition and cathode potential at low c.ds. and they were associated with the deposition of alloys of different phases as revealed by X-ray studies. In the high c.d. range the composition of the deposit was practically constant. Anodes of nickel and zinc were used under separate and joint control, and optimum canditions established for satisfactory corrosion. Anode efficiency measurements checked well with analysis of the plating solutions and anode potentials.

347. Studies in the multistage countercurrent fractionation of unsaturated glycerides.

K. K. ROY, B. T. R. IYENGER and M. M. CHAKRABARTY, Calcutta.

Multistage countercurrent fractionation technique has been applied to the resolution of the glycerides of poppy seed oil with the help of a 'Craig' type, 44 tube countercurrent extraction apparatus assembled in this laboratory. The tubes used were 50 c.c. in capacity. The solvent system employed was a 1 :1 mixture of petrol ether (40°—60°) and furfural, the latter being the hypophasic solvent. Starting with 15 gms. of oil, twenty fractions are collected, yield being from 0·0046 gm. to 4·6 gm. Iodine values in all the fractions were determined by modifying the usual procedure in the case of small quantities. Spectrophotometric analysis for determining linoleic acid was done in the case of eight fractions. Concentration of OOO and SOL, SLL and OOL, and OLL were evident in some of the fractions. The lowest iodine value obtainable was 52 against highest of 159·7 which were much better than that obtained by low temperature crystallisation method, namely 91·1 and 150·0 respectively.

Further work is in progress.

348. Cadmium Sulphide from Cadmium Metal.

K. N. MOORTHY and D. S. DATAR, Hyderabad.

Cadimium sulphide is required by paints and ceramic industries. As imported cadmium salts are costly as compared to the metal, the preparation of the sulphide from cadmium metal will be economical. The process evolved in the laboratory consists of preparation of cadmium salt by dissolving the metal in a mixture of sulphuric and nitric acids and reacting it with sodium sulphide solution. Conditions for obtaining cadmium sulphide in different shades of colour are described.

The process is meant to be used in a small scale industry and provides a reasonable margin of profit.

349. Studies on Bleaching of Castor Oil using Active Carbon from Coal.

T. L. NARASIMHA RAO, M. M. HASAN and D. S. DATAR, Hyderabad.

Active carbon prepared by steam activation of coke obtained by low temperature carbonisation of Singareni coal is found to have satisfactory bleaching property towards castor oil comparable to that of imported carbon used for the purpose.

350. Preparation of Hydrazine Sulphate.

ESHWAR RAJ SAXENA and D. S. DATAR, Hyderabad.

Hydrazine sulphate has been prepared in the laboratory by reacting ammonia or urea with sodium hypochlorite and further reacting the hydrazine produced with sulphuric acid. The synthesis is performed at 80-85°C. and atmospheric pressure instead of 160°C. temperature and 25-30 atmospheric pressure as employed in the usual modified Raschig Process. The reaction is complete in about ½ hour and yield of sulphate is 95%. The process is suitable for small scale production of hydrazine sulphate.

351. Filtrability and Oil Retention of Active Carbons from Singareni Coals.

ESHWAR RAJ SAXENA, T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad.

Filtrability and oil retention of active carbons prepared by low temperature carbonisation and steam activation of coal have been determined. Active carbon grade I is comparable to imported carbons and active carbon grade II has got better filtrability and oil retention than imported activated carbons.

352. Effect of Potassium Chloride on Nitrate Formation in Humus Rich Soil by the application of Nitrogenous Compounds.

S. K. GHOSH, Calcutta.

1. There is much loss of nitrogen when ammonium sulphate or urea undergoes nitrification on the soil surface due to the formation and decomposition of the unstable product ammonium nitrite and hence nitrate formation is very less. Nitrate formation is, however, prominent at lower concentrations of nitrogen.

2. Potassium chloride added to the soil along with ammonium sulphate or urea increases nitrate concentration due to the formation of potassium nitrite which being more stable than ammonium nitrite remains in the system and can slowly oxidise into potassium nitrate. Again the presence of potassium chloride in the solution phase increases the ionic strength of the medium and checks the decomposition of ammonium nitrite due to secondary salt effect.

353. Recovery of Nickel from Dump Slags of Copper Smelter.

M. M. SHARMA, M. P. DIKSHIT and V. A. ALTEKAR, Bombay.

The waste dump slags produced in the copper smelting operations at the Indian Copper Corporation, Ghatsila, contain about 0·23% nickel. The estimated amount of nickel thus available for recovery runs to about 120,000 lbs. per year. Attempt has been made to obtain a nickel bearing concentrate from the slags.

Electrographic technique was employed to ascertain the form in which the nickel exists in slag. The prints revealed that the nickel bearing constituents were finely dispersed as very small particles and that it did not exist as sulphide. The specific gravity of the slag was 3·3 and it was observed that there was no constituent in it which was lighter than 2·96 sp. gr. Similarly gravity—separation experiments with elutriator and Denver's 1 M mineral Jig brought out the non-responsive nature of the slag to this form of concentration. The entire mass of the pulverised slag was magnetic. Ammonia leaching at ordinary temperature and pressure was unsuccessful.

Froth flotation process using pine oil and sodium isopropyl xanthate was tried. It was found that after sulphidising with sodium polysulphide a concentrate was obtained with 80% recovery and containing 2·5% nickel. Further work on flotation of the slag is planned to investigate the effect of various factors.

354. Magnesium Sulphate from Sea bittern.

A. V. RAO and G. T. GADRE, Bhavnagar.

Magnesium sulphate is of considerable economic value and is used in many chemical industries, such as tanning and dyeing, in the manufacture of paints and in the finishing of cotton goods. It is also used for wetting paper, silk and leather.

Magnesium sulphate is manufactured at present in India mostly by the action of sulphuric acid on magnesite. In order to conserve the costly sulphuric acid for better purposes, a simple process for the manufacture of magnesium sulphate using the waste bittern of the marine salt industry as the raw material has been developed in this Institute.

The concentrated bittern (35 5° Be') is chilled to 0°C. by circulating cold brine. The product obtained on cooling is centrifuged and recrystallised The purity of the product is 98 to 99% and the overall yield is about 50%

The process is simple in operation and has the advantage in the fact that it gives higher yields than the existing processes following the similar method.

355. Studies on the Seed and Seed Fat of Moringa Oleifera.

R. D PATEL and L F RABARI, Vallabh Vidyanagar

Composition of seeds of moringa oleifera and characferistics of its oil alone with the composition of component fatty acids are studied Following values are reported.

(A) Composition of seeds Shell % 28 14, Kernal % 71 86, moisture content 4 86%, Ash content 2 60%, oil content 24 80%, crude fibre : 23 40%, protein 30 24%, carbohydrate (by difference) . 14 10%

(B) Characteristics of oil and composition of m f a Refractive index at 25 5°C 1 466, I V (Wij's), 69 86, S V 188 1, acid value 1 56, unsap matter 1 14%, myristic 0 113, palmitic 5 825, stearic 4 384, arachidic 4 751, behenic : 5 572, lignoceric . 1 151, linoleic 0 8, oleic (by difference) 77 404

356. Studies on the exchangeable hydrogen and lime requirement of some typical Indian soils.

S K. NANDI, Calcutta.

Exchangeable hydrogen of soils determined by either Hardy and Lewis' method or by titration with $Ba(OH)_2$ in presence of N-$BaCl_2$ is generally less than the difference between the values of the base exchange capacity and the total exchangeable bases of the soils The lower value indicates that all the exchangeable hydrogen ions are not brought into a state of neutralisation under the condition of experiment Again the higher value of exchangeable hydrogen generally obtained with N-$BaCl_2$-$Ba(OH)_2$ method than with Hardy and Lewis' method is due to the higher concentration (normal) of the Ba^{++} ions and its stronger adsorbability

The lime requirement values of acid soils as estimated by the methods of Hutchinson and McLennan, Schofield and Hardy and Lewis agree amongst themselves within the limits of experimental error

357. Investigation on the chemical composition of hydrogen clays prepared from soils.

S. K. NANDI, Calcutta.

The chemical composition of hydrogen clays prepared from a number of typical Indian soils was determined The SiO_2/Al_2O_3 and SiO_2/R_2O_3 ratios are well correlated with the base exchange capacity of the hydrogen clays. An appreciable quantity of potassium is present as a lattice constituent of the clays, showing the existence of micaceous clays. Potash content in Montmorillonite clay suggests that it is a beidellitic clay. Others are very likely a mixture of clays and contain illite as one of the constituents. Calculation of the lattice composition is possible only with one clay, which as X-ray analysis shows is a more or less pure clay mineral.

358. Possibility of Nickel manufacture in India.

V. A. ALTEKAR, Bombay.

A survey has been made of the reported nickel finds in India with particular reference to the occurrence of nikeliferrous minerals in the copper belt of Singhbhum, Bihar. It has been observed that the ideal way for recovery of nickel would be one which would least interfere with the current established procedure in milling and smelting for copper. It is observed that about 75% of the nickel in the ore is to be found in the tailings; another 15% is to be found in the dump slags and about 10% of the original nickel is being obtained in the refined copper. It is thus seen that a bulk of nickel could be obtainable in the final waste products of the present operations.

Experimental work done by Chatterji *et al,* Altekar and Sandhir, Altekar and Midha on mineralogical and electrographical studies; by Altekar on nickel distribution in, and sink and float studies of the I.C.C. tailings; by Altekar and Midha on gravity and flotation treatment of tailings; by Khare on nickel recovery from nickel-rich circulating slags of the smelter and by Altekar, Sharma and Dixit on treatment of dump slags of the smelter has been surveyed. It has been pointed out that the results obtained so far are not conclusive and that sustained efforts should be continued in this direction. Interest and cooperation of the Indian Copper Corporation is acknowledged.

359. Properties of Ganges Silt.

R. K. SEN and B. CHATTERJEE, Palta and Howrah.

In continuation of our studies on the seasonal variations in the properties of the Ganges silt, the effect of the removal of free inorganic oxides on the chemical, electrochemical and viscous properties of the hydrogen clays prepared from silt samples collected at Palta (Barrackpore) during the premonsoon and monsoon seasons for three consecutive years has been studied. A larger removal of free oxides has been observed in the case of monsoon silts compared to that from the premonsoon silts. The percentages of iron greatly decreases on the removal of free oxides, the other constituents showing variations to a much lesser degree. The monsoon silt has been found to contain more potassium compared to the premonsoon silt. The nature of the variations in the pH and viscosity on the progressive additions of alkalies as also the chemical composition of the hydrogen clays prepared from the Ganges silts indicate the relative abundance of kaolinite in the premonsoon silt while illite constitutes the major clay mineral in the monsoon silt. A slight decomposition of the clay mineral of the 2 : 1 type during the removal of the free oxides is indicated by the observed decrease in the total acidity values calculated at pH 7·0 in the potentiometric titration curves of the hydrogen clays with alkalies. On the removal of free oxides, the inflexion points in the potentiometric titration curves become more prominent and the viscosity-alkali concentration curves more characteristic of the respective clay mineral.

360. Polarisation and polishing studies on Copper in a Hull Cell.

INDRA SANGHI and V. R. RAMANATHAN, Karaikudi.

Results presented in this paper show that the time of polishing has profound effect on the position and size of the polished regions. The effect of sp. gr. of the electrolyte and also the effect of EDTA on the electro-polishing of copper have now been studied. Moreover, the electrolyte level is found to have a marked effect on the curvature of the bands, which also slightly changes with time. It is also found that in a Hull cell the total cell voltage increase regularly with increasing total cell current and no abrupt or rapid changes occur either in current or voltage as observed by Jacquet in an ordinary cell. With a specially designed probe electrode, it has been possible to study the current distribution as existing during polarisation at different points of the anode surface and thus offer some explanation for the appearance of variously polished bands which could not be interpreted earlier in terms of electrode potentials measured with a Luggin capillary and reference electrode. Thus, this work indicates the importance of studying current density distribution which may control such phenomena and which in this particular case also explains why two almost well-polished bands are separated by an unpolished band.

361. Studies on the Oil of Mimusops Hexandra.

R. D. PATEL and L. F. RABARI, Vallabh Vidyanagar.

The characteristics of the oil of Mimusops hexandra and the composition of the component fatty acids are determined. Following values are reported :

Average wt. of seed : 0·1364 g.; shell % : 46·32; kernal % : 53·68; oil content : 23·55%; colour of oil : Bright yellow; R.I. at 31·5°C. : 1·4865; density at 40° : 0·8976; I.V. : 74·75; S.V. : 185·0; unsap. matter : 1·05%; acid value : 1·408; Composition of m.f.a. : Palmitic : 14·37; stearic : 12·76; arachidic : 3·62; linoleic : 9·96; oleic (by difference) 59·29.

362. Preparation of Hydrazine from Urea.

U. P. BASU, Calcutta.

Hydrazine is now a commercial chemical for considerable use. Its industrial production was developed during the last world war in Germany. The process involves the reaction of sodium hypochlorite with ammonia; but the operation needs a high pressure technique. An alternative method of producing it is from urea. India needs the chemical for various purposes and accordingly, a method has been worked out for its production from indigenous materials and in a plant that might be fabricated locally.

The difficulty in its economic production lies in the prevention of decomposition of hydrazine hydrate formed. This has been extensively studied by varying the temperature of reaction as well as introducing suitable catalysts to prevent the above decomposition.

The possibility of its industrial production in India has been discussed.

363. Potassium Sulphate from Sea Bittern.

H. M. BHAVNAGARY and G. T. GADRE, Bhavnagar.

A process has been worked out to recover potassium sulphate from solid obtained by concentrating sea bittern between the densities 36° and 38°Be'. The solid contains potassium chloride and magnesium sulphate in the ratio required for the conversion of potassium chloride to schonite, an intermediate double sulphate of potassium and magnesium, from which potassium sulphate (98% pure) has been recovered by two different methods. The double sulphate ($K_2SO_4.MgSO_4.6H_2O$) and potassium sulphate are useful as fertilisers.

364. Study of Fermentation of Cowdung.

B. THAKUR, B. N. ROY and N. N. SINGH, Patna.

A study of the fermentation of Cowdung has been made. The main object of this work has been to find out a catalytic agent which would accelerate the formation of cowdung gas. Various types of chemicals have been tried but the most suitable one has not yet been found out. Gas consists of methane, ethane, and Carbon dioxide. It has been found suitable for various uses in Science labora tories. Gas evolved was incombustible in the beginning and gradually it became combustible. There was a fixed period when the rate of gas generation was maximum. Calorific value of the gas was better during the peak period, and can be well compared with the calorific values of various types of gases used in Science laboratories.

Residue left in the gas plant consisted of ammonia in various forms, volatile acids mainly formic and acetic acids. Nitrogen content of the residue was essentially the same as that of the fresh cow-dung. The work is still in progress to find out a suitable catalyst. Furthermore, an effort is also being made to use this gas as engine fuel.

365. High pressure synthesis of ethyl propionate from ethylene, carbon monoxide and ethyl alcohol in presence of supported nickel iodide catalyst.

S. N. NAG and S. K. BHATTACHARYYA, Kharagpur.

The reaction of carbon monoxide and ethylene with alcohol has been studied under various conditions of temperature, pressure, molar ratios of the reactants, and residence-period in presence of supported nickel iodine catalyst. A mixture of ethyl propionate, propionic acid, higher hydrocarbons with traces of ether was obtained. The reaction pressure was varied from 100 to 500 atm. the temperature from 200 to 300°C. The maximum yield of ester was obtained at a pressure of 367 atmosphere, a temperature of 230°C. and a molar ratio of CO : C_2H_4 :C_2H_5OH= 2 :2 :1. Using 84% nickel iodide on silica gel as the catalyst, conversions to 42·46% ethyl propionate and 62·08% propionic acid were obtained under the optimum conditions.

366. Synthesis of ester from carbon monoxide and di-ethyl ether under high pressure.

S. K. PALIT, A. K. SEN and S. K. BHATTACHARYYA, Kharagpur.

The reaction between carbon monoxide and di-ethyl ether in various molar ratios, under variable conditions of temperatures and pressures has been studied in presence of supported nickel and cobalt iodide catalysts. The product contained a mixture of esters, acids and aldehydes. The reaction pressure was varied from 1 :0·24 and 1 :0·14. The optimum pressure and temperature for both the catalysts were 225 atmospheres and 230°C. respectively. In case of nickel iodide the optimum molar ratio was 1 :0·24 and in case of cobalt iodide it was 1 :0·14, for optimum ester formation.

Under optimum conditions of temperature and pressure, the conversions of di-ethyl ether have been found as follows :

84% Nickel Iodide on silica gel as the catalyst

22·7% ethyl propionate
12·9% propionic acid
1·07% acetaldehyde

84% Cobalt Iodide on silica gel as the catalyst
30·33% ethyl propionate
11·41% propionic acid
1·79% acetaldehyde.

367. High pressure synthesis of methyl formate from carbon monoxide and methanol in presence of alkali activated charcoal catalyst.

B. N. AVASTHI and S. K. BHATTACHARYYA, Kharagpur.

Catalytic synthesis of methyl formate from methanol and carbon monoxide has been studied using alkali supported charcoal as a catalyst under a pressure of 1800—6000 psi. and a temperature of 100°—250°C.

The optimum temperature, pressure and residence period for the reaction in presence of the best catalyst were found to be 150°C. 3000 psi. and 3 hours respectively.

The yield of methyl formate was found to rise with the increase in the amount of alkali impregnate in charcoal reaching a maximum value of 15·3% (under optimum conditions) when catalyst composition correspond to 50 gms. of alkali per 100 gms. of charcoal. With further increase in alkali concentration the conversion to methyl formate decreased.

368. Investigation on active Iron—Part V. Influence of codeposition of Lead.

G. V. L. N. MURTY and T. R RAMASWAMI, Jamshedpur.

If Lead is present along with iron in the electrolytic bath in a suitable form, the active iron that is deposited is rendered inactive, the amount so inactivated being proportional to the concentration of Lead in the deposit up to a limit beyond which deposition of the active form of iron does not take place at all.

369. A combustion method for the estimation of Sulphur in Ferro-manganese.

G. V. L. N. MURTY and S. K. MAZUMDAR, Jamshedpur.

A modified combustion procedure is described for the estimation of Sulphur in Ferro Manganese and the results obtained by adopting it are compared with those of gravimetric and evolution methods. It is shown that the modified combustion method works out satisfactorily and can be adopted for production control.

370. Poonang oil and its *in vitro* digestibility.

D. MISHRA, Cuttack.

Poonang (Caulophylum inophylum) Seeds were collected from coastal region of Orissa near Puri and the oil was extracted by different methods. The physico-chemical studies of the oil showed mainly Sap. Value 198, Iod. Value 88 and Acid Value 45. The oil was hydrolysed, or *in vitro* digestibility of the oil was determined in order to compare with the *in vivo* digestibility of the same.

It was done by Twitchell reagent and also by enzymatic methods. For the latter the pancreatic lipase and lipases from castor seeds and shaal seeds were used. The splitting of the Poonang Oil, both crude and refined, was compared with Polson butter, ground nut oil and Karanj oil (Pongemia glabra). It was observed that Poonang oil underwent hydrolysis by chemical and enzymatic processes at a lesser extent than the ground nut and Polson butter but when compared to Karanj oil the extent of hydrolysis was found more or less similar. There was no difference in the extent of hydrolysis of crude and refined Poonang oil.

371. Production of high grade Manganese Dioxide concentrates from low grade dump ore from Shimoga District, Mysore.—Flotation concentration.

V. A. ALTEKAR and D. D. AKERKAR, Bombay.

During the course of a visit to the manganese mining area in Shimoga district of Mysore State, dumps and deposits of low grade ores were observed by the senior author. Since several of the low grade samples were potentially promising, about a dozen such samples were collected and a programme of intensive ore-testing launched in the oredressing laboratory of the Bombay University. This paper describes the beneficiation of one particular sample which having failed to respond to simpler gravity separation tests was tested for flotation concentration. After a thorough investigation of various factors like pulp density, pH, collecting agents, modifying agents etc., it was possible to upgrade the material from an original assay of 26·42% manganese and 54·52 % silica plus other impurities, to a finished concentrate assaying 55% manganese, 1·8% silica and other impurities. The overall recovery obtainable was more than 80%. The concentrates contained more than 85% MnO_2.

A very high-grade dioxide concentrate, potentially suitable for chemical and dry-cell use has been thus produced by flotation.

372. Component acids of Indian fresh water fish (Notepterus chitala) visceral oil.

S. P. PATHAK and B. N. TRIVEDI, Varanasi.

The component acids of Chital visceral oil (Iodine value, 76·2; free fatty acid, 0·1%; unsaponifiable matter 1·2%) have been investigated by the usual fractional crystallation and ester fractionation methods. The fatty acids comprise 2·6% myristic, 25·0% palmitic, 6·5% stearic and 0·2% arachidic among the saturated acids. The unsaturated part include C_{14} 1·0%, C_{16} 16·2%, C_{18} 33·4%, C_{20} 12·7%, and C_{22} 2·4%, with mean unsaturation of −2·0, −2·1, −2·4, −3·4 and −4·3 respectively.

The component acids of Chital (visceral) fat strongly support the view that fats from marine fishes and fresh water fishes are of two distinct type. The characteristic points in the fresh water fish fats are the small proportion of unsaturated C_{22} acids, the predominance of C_{18} unsaturated acids and presence of appreciable quantity of hexadecenoic acid (about 10-20%). The mean unsaturation in the unsaturated C_{20} and C_{22} groups appear to be somewhat higher than in the corresponding group of fatty acids from marine species. Further that these fats from fresh water origin show first indication of the tendency to be almost exclusive prominence of oleic acid (with its chemically related polyethenoid acids) amongst the fats of the more developed land fauna and flora.

373. Investigation of the glycosides from Indian Celery (Apium graveolens) and the synthesis of Chrysoeriol.

M. O. FAROOQ, I. P. VARSHNEY, W. RAHMAN and P. C. GANGWAR,
Aligarh.

Further work on Indian Celery seeds (Apium graveolens) using paper chromatographic technique showed that one of the two glycosides already reported (graveobioside B) is a mixture of two components viz. apiin (apigenin-7-apiosyl glucoside) and crysoeriol-7-apiosyl glucoside. The second glycoside, graveobioside A (luteolin-7-apiosyl glucoside) is a pure product. For comparison purposes chrysoeriol has been synthesised by the condensation of carbethoxy-ferulyl chloride and phloroglucinol in presence of anhydrous aluminium chloride in dry ether. The chalcone obtained was cyclised, and purified by chromatography on alumina gave homoeriodictyol m.p. 220-22°. Sodium acetate-iodine oxidation of homoeriodictyol yielded chrysoeriol.

374. Spectrographic analysis of the Fatty Acids obtained from Ocimum basilicum, O. canum, O. kilimandscharicum and O. sanctum seed oil and linseed oil.

M. A. SHAIKH, V. G. SONAR and A. V. PATWARDHAN, Sangli.

The fatty oils obtained from the Ocimum seeds and linseed from plants grown on the premises of the Willingdon College, were saponified and the unsaponifiable matter extracted. The mixed fatty acids were then obtained in pure condition and were subjected in each case to the standard alkali-glycol treatment. The extinction coefficients ($E^{1\%}_{1\,cm.}$) were determined for the bands with the heads at 234 mμ after alkali-isomerisation at 180°C. for 60 min. and at 268 mμ after alkali-isomerisation at 170°C. for 15 min. on a Beckman spectrophotometer DU model (with photomultiplier attachment).

From the observations of E values made in the case of the mixed fatty acids obtained from the oils, percentages of oleic, linoleic, linolenic and saturated acids have been calculated. The percentage of linolenic acid obtained by this method is much higher especially in the case of the Ocimum seed oils than that obtained by bromination and other methods.

375. Non-fatty matter from the seeds of Eclipta erecta, Linn.

R. V. PATWARDHAN, V. G. SONAR and V. A. PATWARDHAN, Sangli.

Eclipta erecta, Linn., known in Marathi as 'Maka' or 'Bhringuraja' is an annual plant belonging to the botanical family-compositae. The plant has a high medicinal value and is abundant throughout India. The seeds used in the present work were obtained from the plants grown in Sangli.

The non-fatty matter in the seeds was obtained after complete extraction of the fatty matter from the crushed seeds by means of ether. On analysis of the non-fatty matter by A.O.A.C. methods, the following percentage composition was obtained: Moisture 8·7, Mineral matter (ash) 10·6, Sand and Siliceous matter 1·9, Crude protein 13, Crude fibre 44·2 and digestible carbohydrates 23·5 (Starch 14 4). Ash contained iron, manganese, calcium, magnesium, potassium, chloride, sulphate, carbonate, phosphate and silicate.

The identification of the amino-acids obtained on hydrolysis of the non-fatty matter has been done by the application of circular paper chromatography. The chromatogram has shown the presence of leucine, phenylalanine, valine, tyrosine, proline, alanine, glutamic acid, serine, arginine, histidine and lysine.

376. Reaction of Iodine in Alkaline solution with Hydrocellulose.

R. NARAYAN RAO and C. S. MARWANI, Bombay.

In order to test whether the reaction of iodine in alkaline conditions, pH 13, can be employed for the estimation of aldehyde groups, five hydrocelluloses with varying copper numbers were prepared and treated with iodine in alkaline conditions. The fall in copper number seems to correspond with the rise in $-COOH$ after treatment under specific conditions.

The oxidation of aldehyde groups of hydrocellulose was maximum in a solution of 0·1N iodine at pH 13 with a period of treatment of one hour at 15°C. Most of the hypoiodite consumed by the hydrocellulose has been found to be used for the oxidation of its aldehyde groups to Carboxyl groups. But since all the aldehyde groups are not found to be oxidised to Carboxyl groups, the hypoiodite method cannot be used for their estimation.

377. Coal gas as a substitute for synthesis gas in the Fischer-Tropsch Synthesis. Effects of temperature and composition of coal gas on the mechanism of reactions.

G. C. BASAK and N. C. NIYOGI, Howrah.

The work embodied in the paper relates to the study of the effects of temperatures and gas compositions on the formation of different hydrocarbons in presence of a catalyst by keeping other variables constant. The catalyst chosen was a cobalt base catalyst with a composition $40Co : 8MgO : 5ThO_2 : 80$ kieselguhr prepared by the authors. The reactions were carried out at three different temperatures varying between 180°C and 200°C using coal gas. The compositions of gas samples were adjusted to $CO : H_2$ ratios varying from 1 :1·5 to 1 :4 in final gases. The results showed that at all these temperatures, highest overall conversion efficiencies and utilisation degree were obtained with a gas composition having $CO : H_2$ ratio of 1 :2. At 200°C the maximum conversion of CO to hydrocarbon formation was possible but the formation of CH_4 being more pronounced, the yield of liquifiable hydrocarbons showed a marked decrease. The yields of hydrocarbon including CH_4 registered progressive rise with increasing ratios of $CO : H_2$ and the maximum was attained at 200°C. Curiously enough, the yields of hydrocarbon excluding CH_4 gave the highest figures only with $CO : H_2$ ratio of 1 :2 and was maximum at 190°C.

378. A modified Baudouin test for detection of adulteration of Ghee or Butter with Vanaspati.

O. P. KAPUR, M. SRINIVASAN and V. SUBRAHMANYAN, Mysore.

Sesame oil alone among vegetable oils and indeed among all fats and oils gives a pink colour when treated with furfural and hydrochloric acid. The reaction is based on the condensation of sesamol obtained by the hydrolysis of sesamolin contained in sesame oil with furfural. The addition of sesame oil to margarine and Vanaspati is compulsory.

Simple as the test is, it can still be performed only with laboratory facilities. It requires the two chemicals, hydrochloric acid and furfural. Furfural being unstable to light (photo-decomposition) on storage, it has got to be freshly distilled for the test. It has now been found that on conversion of furfural into hydrofuramide, this solid, stable substance can be used in small quantities at the time of test, and requires no attention with regard to its preservation. This is a step forward since this test became official under the name 'Baudouin Test' as modified by Villavecchia with the use of furfural. The method of preparing hydrofuramide in quantitative yields which has not yet been so far described in the literature and procedure for doing this test will be discussed.

379. Fabrication of Sintered Type Nickel Cadmium Batteries.

P. V. VASUDEVA RAO, S. GHOSH and H. V. K. UDUPA, **Karaikudi.**

The sintered type nickel-cadmium batteries differ from the flat-pocket and tubular type batteries in the method of support of the active material. Nickel powder is sintered into plates, which are very highly porous. Nickel nitrate or cadmium nitrate are then impregnated into the pores in the form of solution in vaccuo and formed electrolytically to the respective active material for positive and negative. The process of sintering, impregnation and forming are described with graphs to illustrate the performance of the cells assembled in the laboratory.

The capacity of the cells as calculated from the weight of active material is found to be better than that reported in literature.

380. Recovery of Lead values from storage Battery Scrap.

A. K. ABDUL WAHEED, S. GHOSH and H. V. K. UDUPA, Karaikudi

The problem of recovery of lead by a simple procedure from battery scrap consisting of various lead oxides, sulphate etc. has been attempted by several workers. Shaft furnace process is said to be the most economical where treatment of the scrap and subsequent briquetting is essential for the recovery. The method described here consists in heating to nearly 500°C or more the powdered active material and the dross together with commercial sodium carbonate to recover the lead values. It has been noted that addition of alkali with alkali carbonate had no special influence on the recovery of lead values. The actual recovery from discarded battery of the type I.S. 3 CSX 13 has been tried to show that the lead values can be completely recovered by the above simple procedure. This process has possibility of being successfully adopted even on a small scale.

381. Effect of rotation of Cathode on Nickel Plating from Watt's Bath.

K. C. NARASIMHAM and H. V. K. UDUPA, Karaikudi

Nickel deposition was carried out on stationary and rotating cathodes of mild steel, copper and brass at two different composition of the bath. Effect of pH and current density was also studied. The hardness of the deposit obtained under different conditions were determined using microhardness tester.

The probable cause of bright deposit obtained from ordinary Watt's bath using a rotating cathode is discussed in the light of the results obtained now and on the basis of the work of earlier workers.

382. A Paper chromatographic study of the sugar constituents of some important vegetable fibres.

A. K. BANERJEE and G. HALDER, Barrackpore

Although a part of the hemicelluloses present in the plant is removed through attack of micro-organisms during retting, a considerable amount is left with the fibre. The sugar constituents of this fraction was studied in ten different fibres of commerce. These were : Jute from *C. capsularis* and *C. olitorius*, Roselle and Mesta from *Hibiscus sabdariffa* and *H. cannabinus* respectively, Sunnhemp (*Crotolaria juncea*), Manila Hemp (*Musa textiles*), Sisal (*Agave sisalana*), and fibres from *Abutilon indicum* and *Urena lobata*. In the acid hydrolysates of these fibres both pentoses and hexoses were detected by two dimensional paper chromatography. Xylose, arabinose and ribose were found to be the major constituents for most of the fibres. Galaturonic acid was found to be present only in small amounts in two of the fibres studied.

383. Study of the sugar constituents of barks of some fibre producing plants by paper chromatography.

A. K. KUNDU and M. K. MUKHERJEE, Barrackpore.

An investigation was undertaken to study the free sugar and sugars associated with the hemicellulous in the bark of three important fibre producing plants :—Hibiscus cannabinus, Bohemeria nivea and Malachra Capitata and in the leaf of Agave sisalana by paper chromatography. In the free state sucrose, glucose and fructose were detected in all the plants but no pentoses. The major sugar constituting hemicellulose were found to be xylose, arabirose, galactose, ribose and glucose. Small amounts of mannose, rhamonose, ribose were also present. Galactouronic acid was present in *H. cannabinus* and in traces in *B. nivea* and *M. capitata* but was absent in *A. sisalana.* In *H. cannabinus* two unidentified pentoses (u_1 and u_2) and two hexoses (u_4, u_5), and in *B. nivea* u_2, u_4 and in *A. sisalana* u_1, u_2 and another unidentified pentose u_3 and in *M capitata* u_1, u_2 and u_4 were found. R_{xylose} values of u_1, u_2, u_3, u_4, u_6 are respectively 0 90, 1·10, 1·29, 1·40, 1·16 in n-Butanol-pyridine-water and 1·20, 1·16, 1·32, 1·35, 1·35 in water saturated phenol.

384. A new approach to passivity and corrosion inhibition.

K. S. RAJAGOPALAN and K. BALAKRISHNAN, Karaikudi.

In the course of a study on passivity induced by various pretreatment processes for metals, the authors have observed that passivation of the metal surface can be accompanied by a shift in potential in the negative direction in the case of alumina, no shift in the case of zinc and a shift in the positive (nobler) direction in the case of steel. Thus, passivity need not at all be accompanied by a shift of the metal solution potential in the positive direction only. The results are satisfactorily explained by applying Glasstone, Laidler and Eyring theory of rate processes to the potential of a corroding metal surface. The equation for the electrode potential thus derived shows that such shifts in potential as those mentioned above arise from changes in the anodic and cathodic areas. The conclusions thus drawn are fully corroborated by polarisation data obtained on the treated metals.

385. Tensammetric studies on corrosion inhibitors.

K. S. RAJAGOPALAN, V. K. VENKATESAN and K. BALAKRISHNAN,
Karaikudi.

It is shown that the adsorbability of corrosion inhibitors can be conveniently studied at different D.C. potentials applied to the mercury micro-electrode used in classical polarography and at the electro-capillary maximum of mercury, when the mercury surface is uncharged, by using Bryer and Gutman technique for the measurement of the capacity of the micro-electrode. Changes in the capacity of the micro-electrode occur when adsorbable substances are present at the mercury-solution interface. Studies with several organic acid corrosion inhibitors have shown that a number of them exhibit a very high degree of adsorption at the mercury-solution interface. It is also seen that this adsorption extends over a considerable region on the negative side of the electrocapillary maximum in the case of some inhibitors and it is to the same extent on both sides of the electrocapillary maximum in the case of others from which it is concluded that the essential mechanism by which inhibition is given by the former chemicals is cationic while that of the latter is both cationic and anionic.

386. Turbulent medium Tensammetry.

K. S. G. DOSS and V. K. VENKATESAN, Karaikudi.

The effect of surface active substances on dropping mercury electrode capacity can be studied by A. C. palarography. This has been termed as "Tensammetry" by Breyer. It is shown that stirring may increase the sensitiveness of tensammetry over thirty-fold. The results are reported herein of the behaviour of manoxol OT in 0·1 M in KCl solutions. This technique, which is named "Turbulent medium Tensammetry" is shown to be of special interest for estimation of surface active substances as well as in the study of adsorption desorption kinetics.

387. Differential Thermal Analysis studies of Calcium Carbonate and Silica Mixtures.

ABDE ALI and B. V. S. SUBBA RAO, Hyderabad.

Reactions of calcium carbonate and silica mixtures, previously decomposed by heating at 840°C for three to six hours were subjected to differential thermal analysis. The unreacted silica in the reaction mixtures was determined by differential thermal analysis and the free lime by Iodine method. From the data obtained it was shown that tricalcium silicate and tricalcium disilicate were formed when the amount of calcium carbonate in the mixture was in excess and calcium disilicate was formed when silica was in excess. The mechanism of the reaction was explained.

388. Adsorption of Carbon Monoxide on Nickel and Cobalt powder catalysts.

V. SRINIVASAN and K. R. KRISHNASWAMI, Bangalore.

The chemisorption of CO on nickel and cobalt powders has been studied in detail in the temperature range −191° to 300°C. In the case of nickel powder, conclusive evidence has been obtained for the formation of large quantities of nickel carbonyl in the temperature range of −80° to 100°C indicating a bulk reaction, whereas with cobalt not even traces of carbonyl formation could be detected at any temperature up to 200°C.

Adsorption studies of CO on nickel powder at 200°C and above revealed the formation of CO_2 which was found in the gas desorbed after adsorption, indicating the catalytic conversion of CO to CO_2 in the presence of nickel. The behaviour of cobalt was similar to that of nickel in the temperature range of 200° to 300°. Further, the catalytic conversion of CO to CO_2 was manifest even at 0° in the case of cobalt although no CO_2 could be detected in the case of nickel at temperatures below 200°.

Calculations of adsorption of CO on these metals are therefore not feasible at temperatures of 0° and above where an actual chemical reaction takes place.

389. High pressure reaction of Carbon Monoxide with Butane Diol.

G. K. NARAYANA REDDY and M. R. A. RAO, Bangalore.

It has been reported in literature that under high pressure conditions, carbon monoxide reacts with butane diol giving rise to 69% adipic acid. But investigations carried out in this laboratory indicate that when carbon monoxide reacts with butane diol, the major product of reaction is valeric acid. A maximum yield of 47% of valeric acid is produced at a pressure of 4000 psi at 290°C. The yield of adipic acid under these conditions is less than 5%. Free energy calculations for the reaction also indicate that valeric acid should be produced in preference to adipic acid. The effect of temperature, pressure and the relative concentration of carbon monoxide on the yield of valeric acid has been investigated in detail.

390. The reaction between Carbon Dioxide and Amines at high pressure.

T. VENUGOPALA CHARLU and M. R. A. RAO, Bangalore.

Dialkyl ureas are being synthesised by the interaction of aliphatic amines and carbon dioxide. The reaction proceeds with the formation of the intermediate product alkyl ammonium alkyl carbamate which in turn decomposes at high pressures yielding dialkyl ureas.

The effect of temperature and the influence of pressure has been studied employing carbon dioxide and heptyl amine as reactants. It is found that at an optimum temperature 155°C and a pressure of 1700 psi with a residence period of 5 hours, a maximum yield of 31% diheptyl urea can be obtained. An analysis of the compound confirmed the formation of diheptyl urea. The yield of urea diminished with a further increase in pressure at 155°C.

391. Studies in collector mechanism of Xanthates in the flotation of Sulphide Minerals.

S. RAMACHANDRA RAO and C. C. PATEL, Bangalore.

Aqueous solutions of potassium ethyl, isopropyl, butyl and amyl xanthates have been subjected to the action of oxygen, carbon dioxide and a mixture of these two gases with a view to determining the nature of decomposition products formed. In presence of pure oxygen, the products are dixanthogen, carbonate and sulphide. When a mixture of carbon dioxide and oxygen are used, only dixanthogen is obtained. In presence of oxygen, the rate of decomposition is comparatively low, but in presence of a mixture of oxygen and carbon dioxide the rate is much faster. When carbon dioxide alone is passed, the xanthate is decomposed into carbon disulphide and the corresponding alcohol. The decomposition into dixanthogen seems to be favoured in presence of oxygen

The rate of decomposition is considerably lowered when the pH of the solution is raised.

Influence of metal salts like cupric sulphate, ferric sulphate, lead chloride and zinc sulphate have been similarly studied under various conditions. Copper has been found to favour the oxidation in presence of oxygen. Enhancement in the reaction rate has also been noticed with iron salt in the presece of oxygen and carbon dioxide mixture. Lead and zinc ions are found to have no appreciable effect on the rate of the reaction. These observations have been explained.

The Arrhenius' equation for the influence of temperature on the reaction rates has been found to hold good.

392. Sedimentation volume of some ceramic clays.

GURUDAS MANDAL and D. LAHIRI, Calcutta.

Sedimentation volume of clay, clay mixtures, ground clay and also fractionated clay to cover a wide range of particle size distributions and specific surfaces was determined after purification and conversion to H-clay. Sedimentation volume was determined in presence of distilled water and also distilled water containing a few drops of HCl. Though in general sedimentation volume was found to increase with specific surface, the values were considerably influenced by particle size distribution determining packing of particles and also mineralogical composition. A montmorillonitic type of clay had a comparatively smaller sedimentation volume. From the results obtained, the clays could be classified into two groups. First group of clays represented the kaolins giving a comparatively higher sedimentation volume and the settled material being in a comparatively loose condition, easily dispersable by shaking. These clays showed decreased sedimentation volume on addition of acid. The second group of clay consisting of bentonite, ground samples of a kaolin type of clay and a sample of clay suspected to contain montmorillonite settled with a comparatively smaller volume, the settled material was compact and the supernatant liquid was turbid. Addition of acid increased the settled volume considerably and loosened the sedimented product in this case. An explanation for such behaviour has been given.

393. Studies on the purification of some clays of Andhra Pradesh.

M. A. QAIYUM, Hyderabad.

Quantitative mechanical and chemical analysis of four principal clays of Andhra Pradesh were performed to investigate the suitable methods for their purification. Purification of representative samples of Pachegaon, Chintryal, Srirangapur and Shekhapur clays was done by mechanical and chemical methods. Very slight improvement was found in the physical properties of clays after purification. There was very slight difference in the chemical composition of the raw and the washed clays, except in case of Shekhapur clay about 80% of the iron was removed. Further work on the purification of the above clays by Electrophoresis is in progress.

394. Insulation refractories for the high temperature electric furnace.

ABDE ALI, Hyderabad.

To fireclay and Assam sillimanite powder mixtures of 66·67 and 33·33 parts respectively, varying amounts of saw dust (10 to 20 parts by weight) and of coal dust (60 to 75 parts by weight) were added. The mixtures, after being aged, were briquetted, dried and fired to a maximum temperature of 1350°C. The total drying and firing shrinkages as well as the tensile strengths of the various bodies were determined on the sets of six test pieces for each type. The specimens in which coal dust was used were somewhat discoloured and were comparatively less strong. The bodies having 10% and 20% saw dust had sufficient porosity, and tensile strengths of 228 and 137 Kg/cm^2, and total shrinkages of 6·5 and 6·3% respectively. As the heat insulation refractory lid of the electric furnace should have sufficient abrasive resistance as well as porosity, the composition containing 10 parts of saw dust was employed in the fabrication of the lids, which are proving satisfactory.

395. Utilization of spent nickel catalyst from Vanaspati industry—Recovery of fat filteraids and nickel and its reactivation.

OM PRAKASH, ATMA RAM and JAGDISH CHANDRA GUPTA, Kanpur.

Samples of spent catalyst from several hydrogenation factories have been analysed and found to contain 42·2% to 84·2% of fat, 7·0% to 11·3% of nickel and 7·0 to 47·4% of siliceous matter with traces of impurities.

Following 3 methods have been tried for recovering adhering fat from spent nickel catalyst.

(1) Extraction with solvent and centrifuging
(2) Extraction with solvent, settling and filteration.
(3) Digestion by an acid.

The method of digestion with formic acid is the most convenient one for the purpose of reactivation of nickel of the spent nickel catalyst. The method of acid digestion consists in treating spent nickel catalyst with dilute mineral acid or formic acid and stirring it for a few hours keeping the temperature at 105°C. The fat is separated and generally floats on the top and nickel goes into solution in the form of nickel formate. The impurities of iron and aluminium are removed from the solution of nickel formate by precipitating them as their hydroxides using basic nickel carbonate and hydrogen peroxide. The nickel formate obtained above compares favourably with the imported one as regards its catalytic activity in the process of hydrogenation.

396. Manufacture of Lithopone—Part I.

OM PRAKASH, A. C. GUPTA, V D. ATHAWALE and S. S. CHOPRA, Kanpur.

Lithopone which is one of the most important pigments used in paint industry is not manufactured in India so far, whereas its consumption in the country till the imposition of recent import restrictions was estimated at several thousand tons. Work was, therefore, taken up with a view to study the possibility of starting manufacture and to find out working details of the process of manufacture of this important pigment in the country. The process of manufacture in foreign countries is covered by a volume of patents.

This part of the paper deals mainly with a review on the manufacture of lithopone and the possibilities of its manufacture in the country with regard to availability of raw materials and technical knowhow. Results of laboratory experiments conducted so far have been given.

The laboratory work will be followed up by work on pilot plant scale after which the economics of the process will be worked out.

397. Strength of hand made papers—Tensile Strengths.

D. D. JATKAR and S. A. SALETORE, Hyderabad.

In machine made papers, the tensile strength is usually higher in machine direction than in cross direction due to greater alignment of fibres in that direction. This property was also studied with regards to hand made paper the production of which of uniform quality to a great extent is a matter of skill of the operator concerned. Paper sheets 22" wide and 30" long were lifted in hand operated vats and tested in lengthwise and widthwise direction since there is no machine and cross direction in hand made papers. It was found that, generally, the tensile strength was higher in widthwise direction than in lengthwise direction which is contrary to the property exhibited by machine made paper. The possible reasons for this difference between machine made and hand made paper are discussed.

398. Active Carbon from Palana (Rajasthan) Lignite.

T. L. NARASIMHA RAO and D S DATAR, Hyderabad.

Studies on the preparation of active carbon suitable for the adsorption of benzene and acetone were made using Palana lignite The lignite samples were carbonised at 620-640°C and steam activated at 900-920°C The benzene and acetone adsorption at 35°C was 43.1% and 21.9% respectively.

398(a). An approach to the preparation of Cellulose powder for chromatographic separation.

P. P. MUKHERJEE and P. NANDI, Calcutta.

An attempt was made to prepare celluloe powder in this laboratory for utilising in chromatography work.

Absorbent cotton wool was digested with HCl solution (3 : 1) at 80°C for 15 mins. The mass being given a thorough swirling moton from time to time. The mass removed just before gelation, and washed well with disilled water to free from HCl. It was then dried and powdered in a mortar.

Microscopic dimension of the particles in the powder and that of Zellulose, a foreign product were alike. Ash content and adsorption capacity of the powder and of Zellulose were compared.

The dye malachite green was separated from methylene blue chromatographically in the cellulose column. Separation of compounds of biochemical importance by column chromatography are now being studied.

399. Studies on Bleaching of Glycerine using Active Carbons from Coal.

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad.

Active carbon prepared by steam activation of coke obtained by low temperature carbonisation of coal was found to possess satisfactory decolorising property towards glycerine.

400. Prevention of caking of ammonium nitrate—Part III. Comparative study on fatty amine, bone and river silt as coating agents.

ESHWAR RAJ SAXENA and D. S. DATAR, Hyderabad.

The present paper describes the effect of using fatty amine, bone and river silt as coatng agents on the hygroscopicity of ammonium nitrate as such or diluted with calcium carbonate and river silt. It is observed that fatty amine is comparable to bone and silt as coating agent for ammonium nitrate as such but is less effective than bone and silt for diluted salt.

401. Manufacture of Qualitative Filter Paper from Tailor Cuttings—New White Rags.

D. D. JATKAR and S. A. SALETORE, Hyderabad.

Laboratory trials on batches of 100 gms. each of new white tailor cuttings for the manufacture of Qualitative Filter Papers were carried out. The raw material was digested with 1, 2 and 3% caustic soda in different experiments and allowed to ret for different periods of time. The stuff was then bleached and beaten in a small laboratroy Hollander beater to different freenesses and small samples of filter paper were prepared with the help of a laboratory sheet making machine. The samples were tested for their filtration rates by the standard A.S.T.M. method. Some of the samples compared well with foreign samples. Further work is in progress.

402. Studies on the reactive groups of Collagen: Methylation and Guanidination.

K. THOMAS JOSEPH and S. M. BOSE, Madras.

Collagen has been esterified with a number of reagents. It has not been found possible to methylate collagen fully with diazomethane or methyl iodide even when the reaction was allowed to proceed for a large number of days. Dimethyl sulphate and trimethyl phosphate were successful in introducing a large number of methoxyl groups but the reaction was not specific to the carboxyl groups. Some N-methylation also took place with these reagents. Full esterification of collagen was achieved with methanolic HCl and methanol and thionyl chloride in agreement with the results of earlier workers. The reaction was specific to the carboxyl groups and no N-methylation took place as shown by the amino nitrogen determination. A new reagent, methanol and ethyl chloroformate was used to methylate collagen. This reagent was successful in bringing about the full esterification of collagen but a phenomenon accompanying the esterification by this method was an increase in the free amino nitrogen. The effect was reversed in an alkaline buffer and experimental evidences are given to show that it is due to an N-O-acyl shift in serine and threonine residues. Since the reaction was peculiar to methanol and ethylchloroformate it is concluded that it is the catalytic effect of ethylchloroformate which brought about the acyl shift and not the esterification of carboxyl groups. When collagen was treated with O-methyl iso-urea sulphate in alkaline medium about 65% the e-amino groups of lysine were converted into guanidino groups.

403. The Effect of Lyotropic salts on the shrinkage temperature of tanned collagen.

S. GHOSH, Madras.

Salts like $CaCl_2$ $MgCl_2$ and KCNS are known to exert a peptising effect on collagen by breaking the H-bonds responsible for its structural stability. In the present work the shrinkage temperature T^s (which is a measure of the structural stability) of differently tanned collagen has been studied after soaking them in high concentrations (1M and 3M) of the above salts. It has been shown that in case of tanning by formaldehyde, basic chromium sulphate or fish oil, the T_s is lowered showing that at least a part of the groups (peptide or hydroxy proline) taking part in H-bond formation are free even after tanning. In case of vegetable tanning on the other hand, the T_s is unaffected showing that tannin here attacks the above sites of H-bonding and alters the nature of collagen in such a manner that the resultant tannin-protein complex becomes resistant to the lyotropic action of the salts.

404. The iso-electric points of oil-tanned leathers and the mechanism of oil tanning.

S. GHOSH AND Y. NAYUDAMMA, Madras.

In an attempt to elucidate the reactions involved in tanning hide or skin collagen with fish oil, the shift of the iso-electric point of goatskin collagen as well as of formaldehyde and chrome pretanned collagen on tanning with oil, has been investigated by electro-osmotic method. The very low value of the iso-electric point for all the oil-tanned samples, as well as the fact that the values for all are in the pH range 2·5-3, have been interpreted as showing that the main reaction occurring in oil-tanning is the attachment of oxidised fat or fatty acid to the peptide groups of the protein, possibly by hydrogen bonding.

405. Study on the seed oils of Xanthium Strumarium and Pithecellobium Dulce.

R. D. PATEL, N. G. PATEL and L. F. RABARI, Vallabh Vidyanagar.

Following characteristics of the oils from seeds of Xanthium strumarium (I) and Pithecellobium dulce (II) are reported along with the composition of the component fatty acids in m.f.a.

Characteristics of the oil : % oil : (I) 28·13, (II) 11·21; R. I. at 31° : (I) 1·4985, (II) 1·4965; Density at 30° : (I) 0·9185, (II) 0·9003; I.V. : (I) 142·1, (II) 83·7; Acid value : (I) 1·133, (II) 3·024; Acetyl value : (I) 16·44, (II) 14·54; Unsap. matter % : (I) 0·175, (II) 0·5412.

Composition of m.f.a. : Myristic : (I) 0·8654, (II) 2·331; Palmitic : (I) 7·807, (II) 6·234; Stearic : (I) 3·863, (II) 4·313; Arachidic : (I) 0·2951, (II) 5·284; Behenic : (I) 0·3750, (II) 8·065; Lignoceric : (I) 0·9759, (II) 4·212; Linoleic : (I) 69·57, (II) 10·77; Oleic : (I) 16·18; (II) 58·90.

406. Studies of Firing Behaviour of some Clays of Andhra Pradesh by Means of Heating Microscope.

M. A. QAIYUM and ABDE ALI, Hyderabad.

Firing behaviour of four clays of Andhra Pradesh, both in raw and washed states, was studied with a view to get an idea about the proper heat-treatment which they require. The clays were heated at a rate of 20°C per minute up to their liquefaction points in an electrically heated tube furnace to which a microscopic and photographic arrangements were provided and their firing behaviour was observed visually and photographically. The results were compared with those obtained by Travancore Clay and English (Cornwall) China Clay, similarly treated.

The behaviour of Pachegaon, Chintryal and Srirangapur Clays on firing was found almost similar. The results obtained for Shekapur Clay was comparable with the Travancore and the English China Clays. Further work on firing behaviour of finer fractions at different heating rates is under progress.

407. Component fatty acids of the seed-oil of Abutilon Indicum G. Don.

C. R. MEHTA, Ahmedabad.

Extraction of seeds of Abutilon indicum G. Don. (N. O. Malvaceae) with petroleum ether yielded a pale yellow fatty oil (about 10%). The oil has the following analytical constants : *Sp. Gr.* at 30° 0·9226; *Refractive index* at 40° 1·4748; *Saponification Value* 193·8; *Acetyl Value* 3·6; *Acid Value* 6·2; *Iodine Value*

(*Hanus*) 99·2; *RM Value* 0·64; *Polenske Value* nil; *Hehner Number* 90·6; *Unsaponifiable Matter* 2·1%.

The liquid acids (76·1%) consisted of oleic acid (42·7%), linolic acid (27 8%) and linolenic acid (5·6%) while the solid acids (22·1%) were palmitic acid (10·2%), stearic acid (10·9%) and an acid or acids higher than stearic acid (2·8%).

408. Germanium, Vanadium and Molybdenum in Indian Coal and Lignites.

B. DAS SARMA and R. K. DUTTA ROY, Calcutta.

It has been reported from laboratories abroad that germanium showed considerable enrichment in logs embedded in coal fields as well as in Lignites. Over fifty samples of coal, shale and lignites of different Indian localities were analysed spectroscopically. It was found that a number of coal and lignite samples contained high germanium. One sample from the Kangra valley, Punjab, was specially rich, containing 0·6% germanium in the ash. The presence of very high sulphur (over 7%) in this sample may be significant. It has also been found that Molybdenum and Vanadium are also concentrated in some Indian lignites, the maximum found as yet is 0·06 and 0·5% respectively. This programme is being actively pursued as India has yet to find economic deposits for these strategic metals.

409. Refining of Vegetable Oils with Urea.

T. N. MEHTA and M. S. MURTY, Nagpur.

The refining of different vegetable oils of high acidity by means of urea using water as a catalyst has been studied. Urea used amounts to ten times the weight of free acids and the ratio of water to urea is 1 :2. Coconut, palm and rice bran oils of 6%, 21% and 31% F.F.A. have been de-acidified to 1%, 3·9% and 11% F.F.A. content respectively.

410. Refining of Waxes by fractionation with Urea.

T. N. MEHTA and B. N. MURTHY, Nagpur.

Beeswax, carnauba wax and sugarcane wax were refined by extractive crystallization with urea, when pure straight chain compounds were obtained. The waxes were considerably reduced in colour by this method.

The different fractions were analysed for their iodine, saponification, and acid values from which the properties of each fraction were determined.

Sugarcane wax refined by urea has a low acid value as compared to that refined by oxidation methods, and can be used directly as a valuable substitute for carnauba wax.

411. Mode of fractionation of Chaulmoogra oil fatty acids with Urea.

T. N. MEHTA and S. B. DABHADE, Nagpur.

The fatty acids of chaulmoogra oil were fractionated with urea to study the mode of separation. Aliphatic acids separate first and are followed by chaulmoogric, hydnocarpic low alepriclogues of aleprylic and gorlic acids. The lower homologues of hydnocarpic acd and gorlic acid do not form stable adduct with urea at room temperature (30°C).

412. Hydrogenation of Linolenic Acid by Hydrazine Hydrate.

C. V. N. RAO, Nagpur.

Hydrogenation of linolenic acid by hydrazine hydrate at 50°C using a mole ratio of 5 : 1 of hydrazidne hydrate to acid has been studied. Samples were taken out at intervals over an eight hour period and their iodine values were determined. The iodine values obtained indicate that the linolenic acid too can be hydrogenated with hydrazine hydrate.

Infra-red spectroscopy of the samples obtained was studied at 10μ region and the evidence suggests that no appreciable amounts of *trans* acids are formed during hydrogenation by hydrazine hydrate.

413. A continuous process for the manufacture of Zinc Sulphide using Barytes as the source of Sulphur.

S. M. DAS GUPTA and L. N. BALI, Delhi.

The novelty of the present process is that it is a continuous one, consisting mainly of 2 stages :—

1st Stage : In this Zinc Sulphide is precipitated by H_2S gas (produced in stage 2) through a dilute solution of $ZnSO_4$ and then passing the product through regular processes of purification. $ZnSO_4+H_2S \rightarrow H_2SO_4+ZnS$.

2nd Stage : The sulphuric acid generated in stage 1 is allowed to react with Barium sulphide solution producing H_2S gas which is utilised in precipitating ZnS in stage 1. The $BaSO_4$ also produced in this reaction is reduced with coke to BaS which is again the starting point of Stage 2.

$$Pa(OH)(SH)+H_2SO_4=BaSO_4+H_2O+H_2S.$$
$$BaSO_4+2C=BaS+2CO_2.$$

The precipitated $BaSO_4$ can also be marketed as 'Blank fixe'.

The losses incurred by $BaSO_4$ and H_2SO_4 during the processes are replenished by Baryté and 66° Bé H_2SO_4 respectively. Otherwise, the process is a continuous one.

414. Effect of synthetic soil conditioners of the cation exchange capacity of soils and clays.

B. R. NAGAR and TRILOKI NATH, Calcutta.

Cation exchange properties of an Alluvial soil, Rajmahal (Kaolin) and Bentonite clays treated with a number of synthetic polyelectrolytes were studied. Results indicate both increase and decrease in cation exchange capacity, depending upon the nature of polyelectrolytes, soils and clays.

415. Structure of Reticuline, a new Alkaloid from Anona Reticulata Linn.

K. W. GOPINATH, T. R. GOVINDACHARI, B. R. PAI and N. VISWANATHAN, Madras.

Reticuline, isolated from *Anona reticulata* Linn., has the molecular formula $C_{19}H_{23}O_4N$, two methoxyl groups and a tertiary nitrogen atom. Methylation yields a compound identical with d-laudanosine. Reticuline diethyl ether on oxidation under mild conditions yields 1-keto-2-methyl-6-methoxy-7-ethoxy-1 :2 :3 :4-tetrahydroisoquinoline. Vigorous oxidation yields a mixture of 3-ethoxy-4-methoxybenzoic acid and 4-ethoxy-5-methoxyphthalic acid. Reticuline is therefore formulated as 1-(3-hydroxy-4-methoxybenzyl)-2-methyl-6-methoxy-7-hydroxy-1 :2 :3 : 4 -tetrahydroisoquinoline.

NUCLEAR CHEMISTRY

416. A radioactive method for the estimation of sizing efficiency of Textile Fibres.

P. S. KOLHATKAR, P. S. RAO, D. N. S. RAO and A. K. DAS GUPTA, Poona.

An automatic and rapid method for finding the uniformity of sizings on threads and suitability of various sizing compositions, using radioactive tracers, has been developed. Experiments have shown that the carrier-free, easily producible isotope, yttrium-90, with a comparatively short half life, is quite suitable for these investigations, though it is not a constituent of the size.

417. Isotope effect in the electromigration of lithium in agar-agar gel.

H. J. ARNIKAR, Varanasi.

It is shown that the Kendall method of zone electrophoresis in a column of agar-agar gel can be successfully adopted for a partial separation of isotopes. A determination in each of the sections of the total Li content by flame photometry and of the isotope ratio $^7Li/^6Li$ by a constant deviation mass spectrometer designed by Chemla enabled the determination of the relative difference of ionic mobility for the two isotopes of Li ($\Delta v/v$). The Li zone had migrated a distance of 67 cm. after 24 hours of electrophoresis. The values for the isotope ratio $^7Li/^6Li$ measured in the extreme cathodic and anodic ends of the zone were 8·8 and 15·2 respectively, the ratio for natural Li being 11·5. These results give for the relative difference of ionic mobility $\Delta v/v = 0\ 0036$ for the electromigration of the two isotopic ions of Li in agar gel. This last divided by the relative difference of mass gives the *mass* or the *isotope effect* : $\frac{\Delta v/v}{\Delta m/m} = 0{\cdot}023$. ·The 4-times greater value of the isotope effect reported earlier by the author for electromigration of Li in fused salts must be due to solvation effects being negligible in fused salts.

418. Effects of polymorphism and impurities on self-diffusion.

G. D. PALKAR, D. N. S. RAO and A. K. DAS GUPTA, Poona.

The self-diffusion rates of bismuth in pure bismuth oxide and bismuth oxide containing impurities of similar size, but of different charge, have been studied using radioactive tracer techniques. The importance of crystal structure and the effect of impurities on the transport process have been shown experimentally. The rate of diffusion 'D' was found to be enhanced by the addition of vanadium oxide but decreased with cadmium oxide. However, the activation energies remained unchanged. In all the cases the plot of log 'D' against the reciprocal of absolute temperature showed a break at 710°C, the known transition temperature of Bi_2O_3 (monoclinic to tetragonal). The results have been explained on the basis of the accepted theories of the mechanism of diffusion.

419. Diffusion of Monovalent Cations incorporated in Alkali Halides.

A. K. DAS GUPTA and K. P. SINHA, Poona.

Experimental studies on the behaviour of trace quantities of larger sized ions such as cesium and rubidium, incorporated in NaCl and KCl, have led to the observation of a new phenomenon of evaporation of the trace impurities. Using radioactive tracers, the rate of evaporation has been shown to be dependent on the relative sizes of the cations involved, initial concentration of the impurity and the temperature of heating. For each system there is an optimum concentration for maximum evaporation which decreases with increasing disparity of the sizes of the impurity and the host ions.

From the evaporation rates, the values of the diffusion coefficients of the trace ions in different systems have been calculated.

420. On the evaporation of impurity deposits from Alkali Halides.

A. K. DAS GUPTA, Poona.

Fairly high values for the inward diffusion of rubidium and cesium ions in NaCl and KCl are reported in literature. Following similar techniques with radioactive isotopes, it was found that, when RbCl or CsCl was deposited on single crystals of NaCl or KCl, the deposits evaporated from, rather than diffused into, the crystals on heating. Further, this phenomenon of evaporation occurred at temperatures far lower than the melting points of either the crystal or the deposit i.e., at 500°C. The evaporate could be collected by suitable devices. In view of these findings, the diffusion coefficients of larger sized ions cannot be determined by conventional methods. A new approach is suggested.

421. Validity of Onsager's limiting law for the tracer diffusion of Monovalent Ions in Electrolytic Solutions.

D. N. S. RAO, Poona.

Tracer diffusion of cesium in sodium chloride, using radioactive tracer techniques, has been determined at various temperatures and concentrations. It is found that Onsager's limiting law for the tracer diffusion is valid only in dilute solutions. While the diffusion rate 'D' is expected to fall with increasing concentration 'C', it is found that, above 0·16 M, the plot 'D' against '$C^{\frac{1}{2}}$' has a 'hump' with a maximum corresponding to a concentration of 0·36 M. The activation energy for the tracer diffusion of the cesium ion is found to be around 4540 cals. The observed effects are explained on hydration, relaxation effects and dielectric constant.

422. Effect of dilution on the retention value in the Szilard-Chalmer's effect on Tris-Acetylacetone Cobalt (III).

JAGDISH SHANKAR and Z. H. ISRAILI, Trombay.

It has been observed that a dilution of Tris-Acetylacetone Cobalt (III) with Tris-Acetylacetone Aluminium (III) reduces the retention value appreciably, whereas its dilution with Styron 666 (Polystyrene) increases it approximately five times. The results throw considerable light on the mode of thermalization of hot atoms formed as a result of (n, γ) reactions.

423. A study of differential thermal analysis on neutron-irradiated Cobalt-complexes.

JAGDISH SHANKAR, S. B. SRIVASTAVA and RAMENDRA SHANKER, Trombay.

From the point of view of annealing of radiation damage caused by the radiative capture of neutrons, the cobalt complexes may be broadly divided into two categories : (i) the so-called 'open type' characterised by low retention values and insensitive to thermal or radiation annealing, and (ii) 'octahedral type' which exhibit high retention values and are amenable to thermal and radiation annealing. The present study seeks to correlate the phenomenon of annealing with differential thermal behaviour between irradiated and unirradiated metal complexes.

The absence of such differential thermal behaviour and annealing in 'open type' complexes might be due to either poor mobility of the defects in the temperature range studied or due to some mode of their 'stabilization' or 'trapping'.

424. Kinetics of the isothermal annealing in neutron-irradiated Tris Glycine Cobalt (III).

JAGDISH SHANKAR, S. B. SRIVASTAVA and RAMENDRA SHANKAR, Trombay

The kinetics of isothermal annnealing is governed by three first order processes, indicating the presence of several types of damage centres. All the three 'reactions' are temperature dependent. The activation energy associated with the slowest reaction is found to be of the order 32·5 Kcal/mole. The thermal history of the irradiated complex is profoundly reflected on the reaction rates.

425. Antimony-Beryllium Neutron source in activation analysis.

ANIL K. DE, Calcutta.

The present study deals with the application of a portable antimony-beryllium neutron source for activation analysis in conjunction with several different types of scintillation detectors. This neutron source provides the basis of a clean, non-destructive method of analysis of : (i) silver-cobaltic oxide and silver-lead iodide mixtures, (ii) manganese in ferromanganese alloy and pyrolousite, and (iii) sodium iodide in mixtures with manganous sulphate, cobaltous nitrate, nickel nitrate, barium nitrate, zinc nitrate, yttrium nitrate, and cerous nitrate.

The individual elements and synthetic mixtures of elements or their compounds were irradiated with the antimony-beryllium neutron source for a suitable period (8 minutes to 2 hours) depending on the nuclear characteristics of the radioisotopes produced. After a cooling period of 3 minutes, the total gamma radiations of each sample were measured using a scintillation well counter or manual sweep gamma ray spectrometer or an automatic sweep spectrogammeometer, as the case might be. In all cases the results were obtained within ±5-6%. The time required for an analysis varied from 1 to 2½ hours.

426. Study of Szillard-Chalmers reaction on Tris Acetylacetone Co (III).

JAGDISH SHANKAR, S. B. SRIVASTAVA and KUMARI K. BALARAMAN,
Trombay.

Samples of this acetylacetone Co (III) were irradiated to different neutrons and γ-doses in the Materials Testing Reactor (U.S.A.) and BEPO, Harwell, U.K. It is found that the results of study of the kinetics of annealing in the two cases are different, for example, the activation energy of the slower reaction is 7·3 Kcal/mole in the MTR irradiated sample compared with 3-5·7 Kcal/mole reported in the BEPO irradiated sample (Nath, A., et al, Proc. Ind. Acad. Sci., *46*, 29, 1957).

The differential behaviour of the degradation products towards cobaltous, cobaltic carriers and different solvents has also been studied.

SECTION OF GEOLOGY AND GEOGRAPHY

President :—DR. S. C. CHATTERJEE, D.Sc., F.N.I.

Abstract

A. GEOLOGY

(i) General, Stratigraphic and Structural Geology.

1. Note on the Geology and structure in parts of the Almora district, U.P.

M. R. SUBRAMANYAM and R. S. JAIN, Calcutta.

Previous workers have already established that the Garhwal Series of Almora region is exposed in a window bounded by major thrusts. A portion of this window in the Bageshwar-Someshwar region was geologically mapped by the present writers in connection with the copper and lead investigations in the district. Mapping has revealed complex and interestng structural features. Besides major thrusting, intense folding and cross faulting are noticed along with several minor thrusts parallel to the main thrust. This work confirms the position of the major thrusts indicated by Heim and Gansser and would further elucidate the structure tentatively worked out by Nautiyal.

Immediately north of the major thrust zone between Almora and Someshwar, dolomites with overlying quartzites are exposed in a north-dipping isoclinal anticline trending ENE-WSW. The southern dolomite-quartzite contact runs WNW-ESE, and is cross faulted at three places with downthrow to the east. A series of shears and thrusts are seen in the quartzites on the southern limb of the fold with trends approximately parallel to the main thrust further south. The shear zones are marked by crush conglomerates which have much secondary ferruginous cementing. Several of these fault zones are traceable for considerable distances in the area east of Someshwar and south of Garanath.

Further work is in progress.

2. Outline of the Pre-Cambrian Stratigraphy and Orogenic Cycles in parts of Nagpur, Bhandara, Balaghat and Drug Districts, Bombay State and Andhra Pradesh.

S. N. SARKAR, Kharagpur.

As a result of critical investigation of certain key areas within a strip of country between latitudes 20° 50′ and 21° 30′ and longitudes 79° and 81° by the author and his coworkers (Basu and Srivastava), the Pre-Cambrian stratigraphic succession and the different orogenic cycles have been established. These are summarised below :

(In parts of Nagpur, Bhandara, Balaghat and Drug districts)

Vindhyan	Raipur limestone
	Unconformity
Cuddapah	Chandarpur sandstone
	Unconformity (Khairagarh Orogeny)
	Mangikhuta andesite (>2,700 ft.)
Khairagarh Series (18,500 ft.)	Karutola sandstone (<3,900 ft.)
	Unconformity
	Sitagota andesite (<5,000 ft.)
	Unconformity
	Bortalao sandstone (<6,800 ft.)
	Unconformity
Dongargarh granite	
Nandgaon Series (20,000 ft.)	Pitepani andesite (<5,300 ft.)
	Unconformity (Nandgaon Orogeny)
	Bijli rhyolite (>15,000 ft.)
	Unconformity
Sakoli granite gneiss	
	Sakoli Orogeny
Sakoli Series (24,000 ft.)	Basic and Ultrabasic rocks
	Kondebarra formation (>2,000 ft.)
	Chandipahar formation (<5,300 ft.)
	Kharrapahar formation (<4,100 ft.)
	Rampur formation (<5,400 ft)
	Gangajhiri formation (<4,600 ft.)
	Amgaon formation (>6,000 ft.)
	Unconformity
Granites and granite gneisses	
	Sausar Orogeny
Sausar Series (15,000 ft.)	Ramtek group (>2,000 ft.
	Chargaon group (840 ft.)
	Mansar group (500 ft.)
	Ghuksi group (4,500 ft.)
	Mahuli group (2,000 ft.)
	Kalapatha group (5,700 ft.)
	Unconformity (Parseoni Orogeny ?)
	Parseoni group (Series ?

3. Ptygmatic Structures of the area around Simultala, Bihar.

K. C. MISRA, M. N. MAHAPATRA and T. C. Bagchi, Kharagpur.

In the area around Simultala (Lat. 24° 43′ 15″ N.; Long. 86° 27′ 30″ E.) the quartzo-feldspathic veins of small dimensions occurring in the gneisses and schists show very complex pattern of ptygmatic folding. This paper presents the characteristic features of these ptygmatic veins and a discussion on the possible mode of origin of these veins. They cannot be classed as 'primary folds' as suggested by Read, Wilson etc., because the host rocks don't show any evidence of having the necessary physical conditions implied by these hypotheses, at the time of emplacement of the veins. Neither can they be considered as 'Secondary folds' as advocated by Kuenen, Sederholm and his school, and Godfrey, as the features shown by them

cannot be explained by these hypotheses. In the opinion of the authors, the most reasonable explanation based upon the field observation is that, these ptygmatic structures were produced contemporaneously with the growth of the veins in solid state in the host-gneisses and schists.

4. Fold patterns in the Kolhan formation.

S. RAY and M. BOSE, Calcutta.

The 'main basin' of the Kolhan formation from Chaibassa (85° 48′ 30″ Long., 22° 34′ 30″ Lat.) to Noamundi (85° 29′ Long., 22° 9′ Lat.) in south Singhbhum Dunn, J.A. Mem. Geol. Surv. Ind. 63, pt. 3, 1940, p. 342, 351 etc.), is made up of a basal, rather thick bedded, sandstone and conglomerate, then a finely laminated shale (often phyllitic), and a phyllitic laminated limestone. The sandstone-conglomerate rests against the Singhbhum granite along the eastern edge of the basin. All members alike are folded into flat more or less elongated domes, the larger dome surfaces being folded into domes and basins of smaller diameters (25, 50 ft.) and these again into still smaller ones (2½, 10 ft. diameter).

In common with the elongation of the domes which is (i) N-S and (ii) ENE-WSW, the dome tops also show a more or less regular alignment in these two directions. This pattern is evidently due to a common regional deformation plan within this tract of 25 miles length.

Some of the domes are primary and have probably been the starting points for the development of this pattern.

At Jagannathpur, in the shales this structure is succeeded within the basin (i.e. NW) first by northerly dips, then by vertical dips and lastly for about a mile and a half by repeated 'terrace' structure.

The above structures have been measured and mapped (Figs. 2-9) in the field in a few test spots. Structural details are being analysed.

5. Geology of the area around Borio, Santhal Parganas, Bihar.

PRATIP KUMAR MUKHERJEE, Sibpur.

The paper deals with the geology of the area around Borio (25° 2′ 0″ N., 87° 30′ 35″ E.), Santhal Parganas, Bihar. This region is devoid of the Archaean and Gondwana rocks which are commonly found to underlie the Rajmahal lava flows. In all, at least seven basaltic lava flows could be established in this area and, in fact, there must be a few more flows which can be established only with further detailed investigations in the field as well as in the laboratory. The lava flows are more or less all similar in so far as their mineralogical composition is concerned. Plagioclase feldspars occurring in these flows were found to be of labradoritic composition while the pyroxenes are mainly pigeonitic and augitic. The iron ores are mostly magnetite and ilmenite granules. In so far as the texture is concerned, the different portions of the flows were found to exhibit different kinds of textural patterns depending upon the variable rates of cooling in the different portions of the same flow. The "Mode" of a number of specimens was determined with the help of a point counter and the results available revealed clearly that in the relative proportions of the different minerals, as well, there exists no appreciable dissimilarity between the different flows. Moreover, in the same flow, as well, the mineral composition is variable within wide limits and this variation is probably due to the variation in the cooling history of the flow in its different horizons. The order of crystallisation of the different primary minerals was also studied from the petromineralogical observations.

6. The Sausar Sequence—a reconsideration.

NITIN KUMAR BASU, Jadavpur.

From a careful study of the exposure pattern and orientation of different rock units in the map prepared by the author and of the equal area projection diagram of poles to bedding planes in all the formations, a major eastward plunging syncline (Mahuli-Ramtek Syncline) has been established and the following sequence has been derived from this syncline.

Ramtek group 2000 ft.	... Quartzites.
Rocks covered by alluvial soil.	
Chargaon group 840 ft.	... Dolomite. Quartzites and quartz schists. Dolomite.
Mansar group 500 ft.	... Muscovite schists with gondites and manganese ore.
Ghuksi group 4500 ft.	... Dolomite. Muscovite and quartz schists. Quartzites and biotite schists (considerably granitised).
Mahuli group 2000 ft.	... Dolomite. Quartz mica gneisses. Tremolite schist and marble. Felspathic gneisses.
Kalapatha group 5700 ft.	... Calc gneiss. Pink marble Calc gneiss. Pink marble with manganese ore. Calc gneiss.
	?
Parsioni group	... Quartzites.

The following conclusions have been drawn from the present study :

(1) Total thickness of the Sausars exceeds 15000 ft.

(2) There is a regular thickness of schists, gneisses and marbles between the Mansar and Lohangi stages.

(3) Ramtek quartzite is the youngest formation in this area among the Sausars.

(4) Entire Sausar sequence has to be reconsidered in view of the present finding.

7. Zones of the Palaeocene of Lakhpat, N.W. Kutch.

BARUN SEN GUPTA, Kharagpur.

The Palaeogene (Eocene and Oligocene) of Lakhpat (23° 50′ N. : 68° 47′ E.) in N. W. Kutch occurs in several mapable zones, distinguished primarily on the basis of the larger foraminifera. These zones have been provisionally designated by letters and their stratigraphic positions and faunal peculiarities are shown in the composite column given below.

Miocene	Occasionally with the typical echinoid, Breynia carinata.		
			?
Oligocene :	Zone E	Subzone E_3.	Sparsely fossiliferous.
		Subzone E_2.	Scleractinian corals, including Porites sp.
		Subzone E_1.	Mainly Nummulites clipeus (and abundant N. subclipeus). Also Echinolampas damesi, E. cf. indica, E. rotunda, E. feddeni, Clypeaster depressus, C. faloriensis, C. sp., Eupatagus rostratus, Spatangus cf. obliquatus, Hemiaster carinatus. Many molluscs too; including Pecten sp. and Ostrea cf. orbicularis.
	Zone D	Subzone D_2.	Discocyclina (Discocyclina) sp., Nummulites stamineus, Alveolina elliptica, Dictyoconoides cooki.
		Subzone D_1.	Discocyclina (Discocyclina) sp. Rarely with Discocyclina (Aktinocyclina) alticostata in the upper portion.
Eocene	Zone C }	...	Assilina exponens (and A. mamillata). With many Ostrea.
	Zone B	...	Discocyclina (Discocyclina) sowerbyi, D. (D.) dispansa, D. (D.) javana, var. indica. The large gastropod, Turbinellus bulbiformis, occasionally present.
	Zone A	..	Nummulites obtusus.
? Cretaceo-Eocene :	Laterite.		

The strata are mostly horizontal or sub-horizontal and the areal distribution of the zones is mainly controlled by topography. These are zones of marine regression and nowhere has a great thickness been attained.

8. Experimental reproduction in wet clay of en echelon zones of tension and shear fractures.

DEVENDRANATH KANUNGO, Dhanbad.

Experiments with wet clay slabs were conducted to study the manner of formation of *en echelon* zones of tension and shear fractures. The effects of (a) varying water content in the clay, and (b) the varying thickness of the clay slab on the orientation of the cracks were studied. Attempt was made to reproduce the types of structures seen in the field.

9. Structure and tectonics of Archaean Rocks of the area, South of Dantewara, Bastar District, M.P.

A. CHATTERJEE, Kharagpur.

Structural set-up and movement-plan of Archean rocks of an area, south of Dantewara, Bastar Dt., M.P., lying between Lats. 18° 50′ N. and 18° 42′ N. and

Longs. 81° 15′ E. and 81° 23′ E. are being studied. The major structure, east of the Bailadila Range, is that of an anticlinorium. The anticlinorium is flanked by metamorphosed basaltic flows and andalusite-mica-schists both to the east and to the west. The central part is occupied by the oldest rocks in the area, starting from diopside-garnet-magnetite schists, quartz-mica schists, quartzites, calc-schists and grunerite-magnetite schists, being separated from the andalusite-mica schists on either side by granite gneisses. The central zone of parametamorphics with minor granitic intercalations has been repeatedly folded into a series of complex anticlines and synclines. While in the northern part, the axial planes of the folds run almost NNW-SSE with steep easterly dips and axial plunge of about 56° towards N10°E, in the south eastern part fold axes plunge steeply to both ends (towards NE and SW), exhibiting minor culminations and depressions. At least three compressed synclines and two anticlines with general westerly overturning can be established in this area.

Statistical analysis of β-axes (which invariably show pronounced maxima indicating flexure-slip folding) for the different sub-areas reveals a general homogeneity of the movement plan, while comparison of β-axes with B-axes (measured on both minor and major scales) reveals a general coincidence of the two indicating a single major deformation in the area. Transposition cleavage formed at the late stage of deformation is an important planar structure in certain parts of the area. Several important faults, mainly strike-slip and oblique-slip types have also been established.

10. Role of Elasticity in Isostasy.

AMITAVA DUTT, Giridih.

High pressure experiment reveals a wide range of compressibilities or volume change of ultramafic rocks. The writer calculated the hydrostatic pressure at different depths of vertical diabase column of an area of unit cm^2 up to a depth of 40 kms. and tabulated their vertical volume changes at these depths.

Considering a 25% regain of volume over the geological periods it seems that an annual vertical expansion of volume of 300 cu. cm. would need a release of pressure which would be equal to erosion of diabasic material of volume 3×10^5 cu. cm. This also includes partial regain of volume under stress in upper strata.

Actual amount of eroded materials seems to be close to our estimation and therefore the suggested mechanism bay at least partially account for the rise of lands and hills in many snow covered regions. In other words, elasticity may also explain isostasy.

11. Miri Quartzite—and the Buxa Series in the Subansiri valley, Miri Hills, Assam Himalaya.

B. LASKAR, Calcutta.

The Buxa series comprises crystalline grey and cream coloured dolomitic limestones, cherts, quartz-schists, flags of horny black quartzite (touch stone), jaspery quartzite, dark slates, phyllites and low grade schists. There are occasional thin bands of magnetite which contain up to 6 p.c. oxide of manganese. The Buxa series has been sharply folded into an anticline along the Kamla valley, a tributary of the Subansiri river. The belt of the Buxa series has been separated by a thrust fault from about a ten miles wide belt on the south occupied by the younger series of rocks—the Miri Quartzites.

The Miri Quartzite series is thicker than the Buxa, and comprises a vast pile of massive, false bedded, variegated quartzites with several beds of quartzitic grits, interformational gravel-conglomerates and a few bands of indurated brick-red shales which occasionally reveal mud-cracks. The miri series is sharply folded isoclinally and is traversed by reversed faults, causing repetition of beds. These have been thrust on the basal boulder-slates of the Gondwana sequence.

Worn out pebbles of horny black quartzite (touch stone), grey crystalline limestone, chert, jaspery quartzite embedded in the interformational conglomerates within the Miri Quartzites have been derived on erosion of the Buxa series which is older. The higher metamorphism of the Buxa beds also suggests the same.

The Miri Quartzites bear distinctive features and have been found to be older than the Gondwanas but younger than the Buxa—and also the Daling series and have been named "Miri Quartzite series" after the land of the Miri people where these are best exposed.

12. A note on the corrugated structure in the Vindhyan Sandstone near Gangau Weir, Chhatarpur District, Madhya Pradesh.

P. K. CHATTERJEE, S. N. PURI, and P. C. MATHUR, Calcutta.

The paper describes the presence of corrugation like markings in the Vindhyan sandstones, near Gangau Weir (24° 38′ : 79° 51′ 30″, topo sheet No. 54P/14) in the Chhatarpur District, M.P. These markings compare favourably with the fine-textured flute cast structures described by Kuenen from Silurian of Lockerbie, Scotland.

13. Stratigraphy of the Sausar Series in Madhya Pradesh and adjacent parts of Bombay State.

K. D. SHUKLA and M. A. ANANDALWAR, Calcutta.

Recent large scale detailed mapping of over 2,000 square miles of the belt in the districts of Chhindwara, Nagpur, Bhandara and Balaghat by the Geological Survey of India has led to modification and amplification of the stratigraphic succession established by Fermor and West, namely the merging of the Utekata and Kadbikera stages with the Lohangi stage. Introduction of "Sitasaongi stage" at the base of the Series, the recognition of three distinct manganiferous horizons, and the possibility of the Tirodi Gneiss being part of the Sausars.

The succession as established during the present work is given below :—

Stage	Brief description
Bichua ...	... Dolomitic marble, serpentine-bearing, and impure calc-silicate rocks.
Junewani ...	... Biotite-muscovite-schist, quartz-biotite granulite and biotite gneiss; commonly "tabloid" bearing.
Manganese Horizon I	...
Mansar with Manganese Horizon II.	Muscovite schist, muscovite-biotite schist, sericite schist and phyllite; sillimanite-, staurolite-, kyanite-, or ottrelite-bearing.

Stage	Brief description
Manganese Horizon III	
Lohangi	
Lohangi Sub-stage ...	Pink and white calcitic marble, and calciphyre.
Utekata Sub-stage ...	Banded calc-silicate granulite and gneiss, and epidote quartzite.
Kadbikera Sub-stage	Quartz-biotite granulite with epidote and magnetite; gradational into Utekata Calc-granulite.
Sitasaongi	Quartzite, quartz-muscovite schist and quartz-felspar schist; felspathic sericitic schistose grit.
	Disconformity
Tirodi Gneiss ...	Biotite gneiss with bands of amphibolite, hornblende gneiss, calc-silicate gneiss and biotite-muscovite schist ; locally porphyroblastic.
	Unconformity
Older metamorphics of the southern region.	Biotite-hornblende gneiss, orthogneiss and granite, amphibolite, hornblende granulite and charnockitic rocks.

The predominance of marbles and calc-silicate rocks in the west and north of the belt, and abundance of schists in the south and east are clear evidence of a facies change from "orthoquartzite-carbonate association" of Pettijohn to some kind of mixed marine and continental subgreywacke (molasse) association.

14. The Structure of the Sausar Series in the Manganese Belt of Madhya Pradesh and adjoining parts of Bombay State.

S. NARAYANASWAMI and M. R. SUBRAMANYAM, Calcutta.

Recent detailed mapping of an area of over 2000 sq. miles in Madhya Pradesh manganese belt reveals that the rocks of the Sausar Series are intensely folded into overturned isoclinal and recumbent folds; these are affected by several thrust faults, as well as by major and minor strike and transverse faults; at least two distinct periods of deformation are noticeable in the area.

A regional *en-echelon* pattern is discernible in the disposition of the structural elements, with the fold systems and faults shifting northwards as we proceed to the east or west from Nagpur region in the middle.

The structure of the area has been described under four heads with distinctive features in each :

1. Southern belt of overturned, isoclinal folds, characterised by isoclinal folds, with axes trending WNW-ESE in the west and swinging to nearly NE-SW in the east; the axial planes dip 50°—80° to south and the axes plunge 20°—30° to east.

2. Northern belt of recumbent folds, thrust-blocks and nappes, characterised by the three thrust blocks of Ambajhari in N. W. Nagpur, Deolapar in N. Nagpur and Sonawani in N. Balaghat. These thrust blocks consist of overturned recumbent folds, the axes of which are conformable to the regional fold axes of the surrounding area.

3. Central belt of gneissic formations with narrow infolded schists composed mainly of Tirodi gneiss with narrow bands of schists, occupying the region between the other two belts.

4. Regions of Cross-folding and Refolding, consisting of (a) regions with cross-fold axes at an angle of 45° to earlier folds, plunging in opposite directions,

(b) regions of cross-fold axes parallel to the earlier folds but plunging in opposite directions, (c) regions of cross-fold axes parallel and plunging in the same direction as earlier folds, and (d) regions where the plunge of axes of earlier folds is reversed at intervals.

Emplacement of granite plutons and orthogneiss has taken place along the axes of the cross-folds.

Foliation and banding of different types and many kinds of lineation are also described, and are shown to be related to the other major structures.

15. On Cross Folding and Thrust Tectonics from South of Tatanagar, Singhbhum District, Bihar.

A. K. BANERJI, Calcutta.

Megascopic and microscopic fabric studies of a band of quartzites occurring almost at the core of the Singhbhum Thrust Zone 3½ miles south of Tatanagar, indicate that these are cross folded. One set of folds consist of broad warps and micro-puckers associated with mineral lineation and prominent striation lineations with axes striking approx. N. 55° E. and plunging at about 40° corresponding more or less with the regional dip. These are folds and lineations in 'a'. The other set of folds consist of drag folds, micro-puckers and lineations with axes striking approx. N. 40° W. and plunging from 0°-40° generally to the N. W. but sometimes to the S. E. more or less parallel to the regional strike. These are folds and lineations in 'b'. The axial planes of the cross folds often intersect at 90° but sometimes at lesser angles such as 30° in one case. Field relations indicate that the structures in 'a' are earlier than structures in 'b' because the latter appear to have been overprinted upon the former. Three sets of joints are developed in these rocks of which one set represents cross joints and the other two sets longitudinal joints. These rocks have also been affected by normal faults trending N.W.-S.E. The microscopic fabric generally shows a crossed girdle pattern with a prominent girdle about 'a' and a less prominent to weak girdle about 'b'. This indicates that the main phase of recrystallisation of c-axes of quartz was related to 'a' while there was partial recrystallisation during 'b'.

The structural studies indicate that these quartzites, which were originally sedimentary beds with very thin micaceous partings, were subjected to thrusting movements directed approx. from N. 55° E. when these rocks slipped along their bedding planes with intense penetrative movements parallel to the direction of tectonic transport. The a-structures were developed during this phase due to movement and tensional drag on the rock pile. At the close of the period of thrusting the intensity of movements lessened and transport slowed down. During this phase the rock pile was subjected to compressional drag due to retardation in movement and the b-structures were developed. At the end of the period of thrusting with complete relaxation of tension the joint system developed in response to residual stresses. Finally normal faults occurred as a very late tectonic phase.

(ii) Mineralogy

16. Differential Thermal Analysis Curves for some standard clay minerals obtained with a portable D.T.A. Unit.

SRIPADRAO KILPADY and A. G. BHUSARI, Nagpur.

The paper presents the Differential Thermal Analysis Curves for the following eight standard clay minerals : Kaolinite, Dickite, Halloysite, Montmorillonite, Hectorite, Illite, Metabentonite and Pyrophyllite. The curves were obtained with a portable differential thermal analysis unit and are quite reproducible. They are intended to serve as a reference for the interpretation of results obtained from similar portable units. A brief account of the apparatus, procedure and results is followed by a discussion of some of the points of difference between the curves from the portable instrument and the standard unit.

17. Deformation structure in calcite.

SAURINDRANATH SEN, DHRUBAJYOTI MUKHERJEE, and
SUGATA SENGUPTA, Calcutta.

In a coarse-grained calcite marble with 10% to 15% of accessory microcline, diopside, forsterite, and sphene, equigranular clacite crystals show excellent examples of planar deformation structures that have been produced and described in deformed salcite crystals by Turner *et al.* The orientation of the individual planes were, in a majority of cases, accurately obtained from the optic control of the position of c_v, and from one or more planes of (1011) cleavage. In other cases the planes were matched with a complete stereogram of calcite. Among the planes recognized are twin on *e* (0112), which are seldom broad enough to be oriented; they are fine almost hair-line twins on *e*. There are good examples of *deformation bands* (c.f. Orowan) at an angle to the slip lines within the bands. The slip lines have variable spacing, and are along *f* (0221). Sometimes the deformation bands have been microfaulted along the slip planes, and are seen to have a bent outline. The bands show a slight optic disorientation. When two adjacent crystals are of similar orientation the planes could be traced from one crystal to the other.

18. Composition of lateritic manganese ores of Bombay, Rajasthan, Mysore and Orissa.

B. MUKHERJEE and P. R. SEN GUPTA, Calcutta.

X-ray power diffraction method was used to determine the mineralogical composition of the lateritic manganese ores of Bombay, Rajasthan, Mysore and Orissa. Pyrolusite and cryptomelane with amorphous admixture are the main ore-forming minerals. The exact proportions of these constituents are, however, subject to wide variations, though an overall uniformity of mineral composition is evident. Different forms of Fermor's psilomelane are identical with Ramsdell's cryptomelane. Manganese garnet having similar cell size as that of spessartite has been detected in a few specimens; jacobsite has rarely been found as a minor constituent. The rare manganese oxide mineral, ramsdellite (dimorph of pyrolusite) has also been recorded.

The almost constant presence of braunite in the ores as minor constituent may be explained as relict after replacement, or, *in situ* decomposition of manganese silicates. However, it is not possible from the X-ray data alone to determine whether the braunite in lateritoid deposits is primary or secondary. Braunite appears to be primary, at least, in specimens where it is one of the major constituents and is associated with spessartite.

19. Occurrence of Green Mica in Khondalite from Auranga-Koel Valley, Palamau, Bihar.

RAGHUJI VERMA and G. C. BHATTACHARYA, Ranchi.

Chemical analysis of a green mica from Auranga-Koel Valley, Palamau, Bihar, showed that it contained a fair amount of Vanadium, Chromium and Titanium. As no such mica seems to have been hitherto reported from Chhotanagpur, it is proposed to have a detailed mineralogical study.

The mica occurs in khondalite rocks in the Bhusaria hill nearly two miles north of the Kechki Railway bridge and is emerald green in colour having flakes up to 1 m.m. in diameter. The chemical and optical properties and origin of this mica have been discussed.

20. Formation of Epidote Minerals in the Auranga-Koel Valley, Palamau, Bihar.

RAGHUJI VERMA, Ranchi.

The Auranga-Koel Valley is dominantly occupied by Granites and Granite Gneisses which are of two generations and older, rich in feromagnesian constituents and preponderance of oligoclase over potash feldspars and an younger granite rich in microcline and perthites. These granites have been intruded by a system of dykes of basic to ultrabasic composition. The granites are capped here and there by a few patches of metasediments having varied mineralogical composition and Gondwana sandstones.

In an earlier communication (1955) the author has reported the occurrence of a sheared zone in this area.

One of the important features of the rocks of Auranga-Koel Valley is the formation of epidote minerals in them. The process of epidotisation in these rocks, specially of the sheared zone, has advanced to such an extent that numerous occurrences of almost pure epidotic rocks have been found.

Harpum (1954) has described four principal environments for the formation of epidote minerals in Tanganyika. They are—(1) dislocated lime-bearing rocks, (2) metasomatised or metamorphosed lime-bearing rocks, (3) rocks that have suffered lime metasomatism, and (4) acid magmatic rocks by calc-silicate xenoliths.

Study of the micro sections of the rocks of Auranga-Koel-Valley has revealed that in the formation of epidote minerals the different environments, particularly no (1) and (3) of Harpum, were in operation. Clinozoisite, Zoisite, Allanite, Epidote and Piedmontite minerals have been produced in different rock types depending upon their original composition and the intensity of dislocation or metasomatism they have suffered. The phenomena afford excellent examples of environments for the formation of epidote minerals. The work is under progress.

21. On the occurrence of Allanite in Bankura District, West Bengal.

K. L. DAS, Howrah.

During mineral exploratory traverses in the western parts of West Bengal, the author came across this mineral in a place situated between the mouzas Madhabpur and Tilaboni in the south-western parts of the district of Bankura. About two maunds of this mineral was collected from soil covering. There are rocks like pegmatites in the surrounding areas, which might be the source of the mineral. One sample was analysed for its ThO_2 and Ce_2O_3 contents. It was found that in that particular sample, ThO_2 was absent but Ce_2O_3 was 21·35%.

22. Study of Ilmenite bearing Quartz Veins from Rautara, Bankura Dt., West Bengal.

PRIYA SHANKAR CHAKRAVARTY, Jadavpur.

Occurrence of ilmenite bearing quartz veins has been spotted by the author near Rautara (22° 49′ N; 86° 39′ E), Bankura District, West Bengal. The associated garnet-staurolite-sillimanite-muscovite-schists dip at a high angle of 45°-60° towards N.N.E. The veins run parallel to the foliation strike of the country rock. The quartz veins have been locally sheared with development of close-spaced jointing. The ilmenite from the highly sheared portion of the veins has developed numerous conjugate slip-planes, some of which can be megascopically recognised. The shear planes developed in quartz vein marked by lensoid grains of quartz are at angle with the megascopic slip-planes in ilmenite owing to difference in competency between the two minerals.

Major slip along one or more important faces has resulted in subsidiary slips along available cleavage, twinning and other oblique surfaces. Interesting textural features comprising translation gliding, twin gliding, intersecting translation units have been described. A specimen polished on several faces up to 600 carborundum stage was examined in incident light to study the orientation of slip-planes. The composite polar diagram of all available planes was superimposed on a complete stereogram of ilmenite from published interfacial angles. From complete matching of the poles it has been concluded that prominent translation planes are 0001, ($t = [10\bar{1}0]$) and $10\bar{1}0$. Minor slip planes include $\bar{5}054$, $\bar{2}021$, $\bar{1}122$, 55103 and $21\bar{1}2$. Localisation of the blebs and spindles of exsolved haematite along twin-planes in ilmenite from sheared portion of the vein indicates prominent role of deformative stress in bringing about the exsolution.

23. Twin and translation gliding in feldspar.

SAURINDRANATH SEN, Calcutta.

Mechanical twining (*twin gliding*) was induced in feldspars by Mügge and Heide; and evidences and examples of *translation gliding* were described and sketched in an earlier paper by the author. Further work has enabled to work out the details of translation gliding and recognition of twin gliding in labradorite. The feldspar has an elongated feathery habit, and each individual crystal shows at least one conspicuous separation plane, more often a bunch of a number of subparallel planes. Evidence of gliding along these planes is obvious in the torn off appearance of the crystal, and in subsidiary gliding along inclined planes producing torn off edges. Translation has occurred along {150}, $\{1\bar{5}0\}$, {101}, {010}, and {001}. Predominant bend gliding has resulted in a slight optic discontinuity. In one highly sheared specimen, the feldspar, together with hornblende and pyroxene, show extreme stretching, and in feldspars there are beautiful examples of features that could be described as *deformation bands*. There are good examples of twin gliding; the two units separated by the conspicuous separation plane show a rational orientation change so that one could be derived from the other by a rotation through 180° on the composition plane round an axis lying on it or normal to it. Sometimes herring-bone twins have been produced, on the composition plane {010}, in the Albite Law, whereas the symmetrically disposed twins on either side is in the Acline Law on [010] in (001).

24. Twin laws and zoning in plagioclase porphyroblasts in orthometamorphites from Manikpur area, Drug District, Madhya Pradesh.

S. N. SARKAR, Kharagpur.

Intensive field and petromineralogical studies of the hornblende-rich patches in the felspathic quartzites from Manikpur area (21° 8′ : 80° 44′) in Drug District show that the epidiorites of the Amgaon formation (basal Sakolis) occurring as inclusions in the Bijli rhyolites (Nandgaon Series) are thermally metamorphosed by the

Dongargarh granite (post-Nandgaon and pre-Khairagarh Series in age). The degree of metamorphism in the epidiorite inclusions vary considerably within a few centimeters and the different stages are traceable. In the early stages the plagioclase metaphenocrysts become turbid and patchy, and twinning disappears almost completely. In the portions exhibiting higher degree of metamorphism the plagioclase porphyroblasts show complete recrystallisation with the development of complex twinning and zoning. Most of the porphyroblasts exhibit both twinning and zoning. Twinning after albite, pericline, albite-Carlsbad complex, albite-Ala B complex laws, etc., are common, and ubiquitous zoning is of the normal type. Central parts of plagioclase porphyroblasts vary in composition from An$_{39}$ to An$_{57}$ in different cases, whereas towards the borders the composition becomes more sodic up to An$_{17}$. Apart from compositional variation due to zoning, variation of composition in contiguous twin lamellae is often noticed. Variable width of the peripheral zones of sodic composition and their patchy character are due to metasomatic metamorphism by sode influx during granitisation. From this study it is apparent that the theories such as (1) "Polysynthetic twinning and zoning tend to be mutually exclusive" (Emmons, et al) and (2) "Complex twin laws are rare in metamorphites" (Turner, Gorai, are not applicable in this case.

25. On the variation in the size of plagioclase grains in the Basaltic Lava flows of the area around Borio, Santhal Parganas, Bihar.

PRATIP KUMAR MUKHERJEE, Sibpur.

The paper deals with the study of the size of the plagioclase feldspar grains which occur in the lava flows of the above area. Plagioclase was chosen for this study since the mineral is found to have a remarkable tendency towards idiomorphism. Both the lengths of the grains as well as their breadths were measured, under the microscope, with an eyepiece micrometer and the results available from these measurements were plotted in the form of h[illegible]ograms and frequency curves. In this work a geometric scale of class intervals was chosen due to the fact that such scales ignore small differences in size in the large size groups but put due importance to the same in the smaller size groups.

For each specimen two curves were constructed—one with the length and the other with the breadths of the plagioclase grains. The results obtained from the study of some forty specimens show that at the tops and bottoms of flows the grain size exhibits a bimodal distribution As the middle portions of the flows are approached, however, there is a progressive tendency towards unimodal distribution of the grains. This is suggestive of the fact that while in case of the middle portions of the flows there has been no appreciable change in the cooling history of the extrusive magma, in case of the upper and lower horizons of flows, there has been a significant change in the cooling history of the flows as the magma passed from the intratelluric stage to the effusive stage. In most of the cases, the curves available were similar irrespective of whether they were constructed with the lengths or the breadths of the grains. Some minor variations are due to the extreme sensitivity of the lengths of the grains to changes in the prevailing external conditions of temperature and pressure. Further work in this line is under-way.

26. A note on Manganotantalite.

A. BHASKARA RAO, Brazil.

Manganotantalite (a multiple cxide of tantalium, Manganese, and Iron, with Mn :Fe>3 :1) in association with tantalite, from Equador, Rio Grande do Norte, Brazil, is described in this paper.

Translucent dark reddish brown crystals of manganotantalite, with hardness 6, greater on [001] and [021] than on [201], and specific gravity of nearly 7·5, gave an yellowish white streak. Orthorhombic in system, and not included in Goldschmidt's Atlas of crystal forms, they have macro and brachy domes, and basal pinacoid. The macrodome faces exhibit striations and step-like "growth accessories" of Goldschmidt. Certain cracks and breaks in the striations are considered to be due to the confluence of growth liquids.

27. Deviation of peak temperatures in DTA curves of Calcites.

A. BHASKARA RAO, Brazil.

There are some interesting works, published recently, on the magnesian calcites in nature, and in artificial mixtures, giving X-ray data.

With a view to supplement this work, several types of calcites containing up to 20% of $MgCO_3$ from different localities, have been subjected to differential thermal investigations. All the curves show variations in peak temperatures, with a fair decrease corresponding to an increase in the content of Mg, Fe, and Mn, in calcites. But most of them show the same starting temperature of reaction. Further work with higher amounts of impurities might be interesting.

28. Acadialite from Brazil.

A. BHASKARA RAO, Brazil.

Acadialite, the reddish variety of Chabazite {chemical composition being $(Ca,Na_2)\ Al_2Si_4O_{12},\ 6H_2O$} of the Zeolite famliy, is collected from Currais Novos Rio Grande de Norte, Brazil.

Beautiful crystals of rhombohedrons, about 2 mm. in dimensions, occur in the limestone-mica schist region, in association with quartz, and stilbite. They are deep red and orange red in colour and transparent. Hardness is about 4, and luster is vitreous, with a white streak. Optically positive, they have a refractive index of 1·472 ± 0·002.

Twins and complex growths are present as represented in the Goldschmidt's Atlas of Crystal forms, in Figs. 44, 68, 119, and 120. The rhombs are more like cubes and they show prominent cleavage. The "growth accessories" are represented by fine and furrow like striations, deviating to different directions due to twinning. Some of them are rugged giving rise to ascending growths, like 'terraces.'

Another specimen has honey yellow to light orange crystals of chabazite, and they might be the other variety Haydenite.

29. Some aspects of minor elements geochemistry of selected plagioclase feldspars.

SISIR K. SEN, Kharagpur.

The distribution of Ba, Sr, Fe and Ti in some natural plagioclases has been studied. The variable contents of these minor elements have been interpreted as being caused mainly by an interaction of temperature and availability. Temperature is advanced as a principal control in increasing the "solubility" of the elements concerned in plagioclases, as explained on crystal chemical grounds. The role of the chemical environment in its two major manifestation,—the relative availability of the elements and the nature and amount of the coexisting minerals has been found to be important. The stability of Fe and Ti in plagioclase structure is discussed in connection with exsolution. An association of K with Fe is briefly considered. A general trend of increase of the minor element contents in plagioclases from amphibolite facies→granulite facies→volcanics has been observed. Within plagioclases from the same groups where the differences of respective minor element contents are significant, e.g., among the granulite facies and the volcanics, the trends of variation are more or less parallel, suggesting a common temperature control. The exceptions to this parallelism are caused by factors of availability and exsolution-migration.

30. On the nature of Arizonite.

M. D. KARKHANAVALA, Bombay.

The evidence for discrediting the mineral is analysed to show that the natural mineral cannot be regarded as a mere mixture of hematite, anatase, rutile and possibly ilmenite. Also it cannot be regarded as simply weathered ilmenite, though it may possibly be an alteration product of ilmenite formed under hydrothermal or metasomatic conditions. It is concluded that the mineral arizonite represents a specific and unique, though somewhat rare and unstable, chemical compound. This is also supported from the author's separate work in the system Fe_2O_3-TiO_2.

(iii) Petrology

31. The source of the Deccan Trap flows.

W. D. WEST, Sagar.

The study of the geology of the country around Sagar, M.P. has raised some problems concerning the Deccan Trap. These are : (1) where did the flows come from ? and (2) how far did individual flows extend ?

Assuming that the flows issued from fissures, now seen as dykes, it is difficult to account for the source of the flows that make up more than half the Deccan Trap outcrop, where no dykes are found.

With regard to the flows that occur around and to the north-west of Sagar, the nearest dykes are more than 75 miles away. But detailed field work suggests that the flows could easily travel this distance, and probably much further. It is suggested, therefore, that the flows were extruded only in those areas where dykes occur, i e. in Cutch, Saurashtra, the N. Konkan, the lower Tapti and Narmada valleys, and the Gondwana basins of the northern Satpuras, and that the flows travelled great distances to other parts of the outcrop.

Recent geodetic computations by Glennie support this view.

32. A note on the Anorthosite at Koraput, Orissa.

MIHIR KUMAR BOSE, Calcutta.

A lensoid body of anorthosite, not reported earlier, has been mapped to the east of Koraput (82°43′; 18°49′), Orissa. The body trends NNE-SSW for more than a mile, parallel to the regional strike of the country. The latter is constituted of garnetiferous-quartz silimanite gneiss (Khondalites), garnetiferous quartz plagioclase-hypersthene gneiss (? Charnockite) and calc-granulites.

The central part of the anorthosite body is composed of plagioclase (andesine) with or without biotite ($\beta = 1{\cdot}664$), amphibole ($\alpha = 1{\cdot}6803$, $2V_x = 82°$, $Z \wedge c = 15°$), pyroxene $\gamma = 1{\cdot}710$, $2V_z = 62°$, $Z \wedge c = 40°$) and garnet, having a coarse hypautomorphic texture, without significant amount of protoclasis.

The mafic constituents, increase towards the eastern and southern periphery. They also form mafic (hypersthene, plagioclase, biotite, ± garnet) and ultramafic (hypersthene, amphibole, biotite and spinel) bands within the body as well. A thin band of pegmatitic granite (sheared) without apparent genetic relationship with the anorthosite, runs along the eastern margin of the latter.

There have been mineral transformations within the anorthosite e.g., pyroxene to amphibole, iron ores to biotite, biotite to garnet. The rock shows weak fracture cleavage all through and towards the eastern margin it is locally granulitic and shows mylonitisation.

33. Crystallisation in relation to periods of deformation in the Pelitic Schists around the Kuilapal Granite-gneiss in S.W. West Bengal.

SUBIRKUMAR GHOSH, Jadavpur.

The following time-relationships between crystallization and deformation have been established from study of the pelitic schists in the area between Dhadka (22° 47′ 37″; 86° 30′ 22″) and Sutan (22° 48′ 30″; 86° 43′ 54″) in S.W. West Bengal.

Crystallization of garnet started after an initial schistosity was impressed upon the rocks, and continued during development of this schistosity by planar slip, with para- and post-crystalline rotation of the porphyroblasts. Excepting a few instances of paratectonic crystallization in the eastern part of the area, garnet is entirely pretectonic with reference to the puckering of the schistosity. Staurolite had started crystallization under quiet conditions after the development of the schistosity. It is pretectonic in relation to puckering of the schistosity as is indicated by evidence of postcrystalline rotation, development of undulatory extinctions and folding of elongate grains. Sillimanite is post-tectonic in relation to the formation of the early schistosity, and is pre-tectonic in relation to puckering and transposition of the schistosity.

Recrystallization of quartz, muscovite and biotite has, in general, outlasted the puckering movement in these high-and middle-grade rocks, and neocrystallization of retrograde chlorite and biotite is always post-tectonic with reference to puckering.

Thus the progressive metamorphism took place during and after the development of the schistosity, and was followed by the puckering of the schistosity, when the progressive metamorphism had already ended but the rocks were still at a fairly high temperature so that thorough recrystallization of biotite and rare localized crystallization of garnet were possible.

34. A preliminary note on the Nepheline Syenite at Koraput, Orissa.

MIHIR KUMAR BOSE, Calcutta.

Occurrences of nepheline syenite, first reported by Walker (1907), have been examined to the east and north-east of Koraput 82°42′; 18°49′), Orissa. The major occurrence is a narrow elongated body, trending NNE-SSW for about a mile, parallel to the regional strike of the country. Two minor occurrences have been encountered, one associated with an anorthosite body and the other in khondalites. The major body is granitoid in the central portion and weakly foliated near margin; one of the minor bodies is medium grained granulitic (ditroitic) with a faint foliation. The rock consists of microperthite and nepheline ($N_0 = 1{\cdot}536$). Albite forms rims and veins in the potash felspar. Amphibole ($\beta = 1{\cdot}6944$, $2V_x = 72^\circ$, $Z \wedge c = 15^\circ$) and biotite ($\beta = 1{\cdot}6403 - 1{\cdot}6543$) occur in association, the one or the other being dominant. Calcite occurs interstitially and occasionally forms row.

The central part of the major body is biotite-nepheline syenite. Along the eastern periphery occurs a potash syenite. The western portion of the body is associated with an anorthositic rock, composed dominantly of plagioclase (andesine) together with calcite, scapolite and invasive microperthite. Scapolite is also noted in nepheline poor syenite, in the western margin.

The biotite-nepheline syenite has a normal chemical composition.

35. Lithology and Petrology of the Talchir Rocks near Burhai.

M. N. MAHAPATRA, K. C. MISRA and C. NARASIMHA RAO, Kharagpur.

Sedimentaries belonging to the Talchir stage, occur in three small outliers near Burhai village (24°21·5′N, 86°33·5′E) Santhal Pargana district, Bihar. The chief petrological types include the boulder conglomerates at the base, followed by mauve sandstones and shales, with chloritic arkoses at the top.

The boulder conglomerates are heterogeneous in nature and include all sizes varying from gravels to fine clay. They have a polymodal distribution, ill-sorted nature and are negatively skewed.

The mauve sandstones are unimodal with a chief modal class in the 0·177 mm. size grade (medium sand size). They are positively skewed and are fairly sorted.

The chloritic arkoses also have a unimodal distribution presenting a chief modal class in 0·177 mm. (medium sand size) size grade. They are positively skewed and are well sorted.

Thus the sediments in this area show a progressive improvement in their sorting up the sequence, which is in perfect conformity with the pattern of sedimentation. The conglomerates and mauve sandstones are deposited as ice contact stratified drifts, while the uniformly stratified, medium grained, chloritic arkoses indicate a deposition under uniform conditions. They are believed to have been deposited by the proglacial streams beyond the limits of the glacier.

36. Occurrence of Calc-silicate rocks around Bagodar—Kodarma area, Hazaribagh District, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

The paper deals with the geology and petrology of the calc-silicate rocks, recorded for the first time in the area lying between Latitudes 24°0′-24°30′ and Longitudes 85°30′-86°0′ in the district of Hazaribagh, Bihar The calc-silicate rocks occur as narrow, elongated and discontinuous patches and as small mounds and elongated ridges in granite gneisses, and schists. Their strike and dip are, in most cases, concordant with the country rocks. They exhibit granulitic, gneissic and schistose structures, the granulitic being the most common

The calc-silicate rocks include the following types: (1) Calc-granulites represented by calcite-diopside-, calcite-actinolite-, calcite-hornblende-zoisite-, garnet-hornblende-, garnet-epidote-allanite-, diopside-epidote-, garnet-pyroxene-, hornblende-diopside-, actinolite-diopside-, hornblende-clinozoisite-actinolite-, garnet-epidote-, and diopside-augite-zoisite granulites.

(2) Calc-schists, the varieties of which are: calcite-actinolite-tremolite-quartz-, calcite-actinolite-quartz-chlorite-, actinolite-tremolite-, hornblende-zoisite-chlorite-, garnetiferous actinolite-chlorite-, and clinozoisite-hornblende schists.

(3) Calc-gneisses consisting of calcite-quartz-zoisite-, hornblende-clinozoisite-, allanite-diopside-clinozoisite-, calcite-diopside-hornblende-, calcite-hornblende-, and garnet-epidote-diopside rocks.

Felspers (plagioclase mostly) are among the essential minerals. Sphene, zircon, chlorite and magnetite are the common accessories. Graphite and apatite are rare.

37. Metamorphism in the Saugar Series in the Manganese Belt of Madhya Pradesh and adjacent parts of Bombay State.

N. A. VEMBAN and G. V. RAO, Calcutta.

A regular increase in the grade of metamorphis is noticed in the Sausar Series from the S.E. to N.W.

The low grade rocks are best developed in south-eastern Balaghat district, where chlorite, sericite, ottrelite and fine-grained garnet are developed in phyllites and schists of Mansar stage. Manganese silicates and gondite are not developed, but the ore bodies are characterised by fine-grained braunite, admixed with hollandite and cryptomelane.

The intermediate zone of staurolite and kyanite is best developed in eastern Balaghat and north-eastern Bhandara. The associated marbles and calc-silicate rocks show amphibole, epidote, grossularite, sphene and plagioclase and subordinate diopside. Gondite and manganese silicate rocks are prominently developed and the associated manganese minerals are spessartite, amphiboles and piedmontite.

In the sillimanite zone of metamorphism, well developed in north-western Balaghat, Nagpur and Chhindwara districts, the schists contain muscovite, biotite, abundant sillimanite, dumortierite and iron-rich garnet. The associated marbles and calc silicate rocks show diopside, wollastonite, actinolite, epidote, chondrodite, sphene and plagioclase as well as microcline. The manganese-ore deposits are composed of coarse-grained braunite with subordinate jacobsite and hollandite, the associated manganese-silicates being manganese-pyroxenes and amphiboles. In the vicinity of granite plutons, sillimanite changes to fibrolite or is converted into felspars. The quartzites become vitreous and often coarse grained.

The metamorphic zones have a general spatial relationship to structure. The isograds trend NE-SW at an angle to the regional structure of the rocks. The retrograde metamorphism noticed in southern parts of northern Bhandara is probably associated with the late-stage cross-folding in this area.

38. Contact Metamorphic Skarns in Calc-granulite at Garividi, Srikakulam District, Andhra Pradesh.

G. V. RAO, Calcutta.

Granite veins cutting through calc-silicate granulites on the small hillock adjoining Garividi R.S., in Srikakulam district, Andhra Pradesh, show remarkable contact metamorphic effects. The normal calc-silicate granulites away from the granite contact is composed mainly of quartz, scapolite and diopside and minor proportions of potash felspar, calcite, sphene and opaques. The coarse grained granite veins are on an average about 6 feet thick and show quartz, microcline and orthoclase. The fine grained calc-granulite, which has a grain size of 0·25 to 0·5 mm., has been recrystallised to a medium grained rock, 1 to 2 mm. in grain size within a few inches of the granite contact. Coarse crystals of dark green diopside measuring up to 5 mm., are common at the granite contact. The chief mineralogical change is the complete disappearance of scapolite and quartz, the former making up nearly 40% of the normal calc-granulite, and development of andesine, which together with diopside in nearly 2 : 1 proportion, now makes the recrystallised rock. There has also been introduction of quartz and potash felspar. Optic determinations indicate that the mizzonite (Ma_{50} Me_{50}) variety of scapolite in calc-granulite changes towards the meionite (Ma_{35} Me_{65}) end nearer the skarn zone and the ferrosalite variety of diopside changes towards the salite end nearer the granite contact. Introduction of soda and development of andesine from scapolite seem to be the main effect of the granite on the calc-granulite.

39. Precambrian graywacke in Gadag band of Dharwar schists in Mysore.

S. NARAYANASWAMI, Calcutta.

Reconnaissance survey in the auriferous tract of Gadag band of Precambrian Dharwar schists in Mysore has brought to light an interesting association of meta-graywacke in association with greenstone, greenstone conglomerate, chloritic phyllite, limestone, banded ferruginous-quartzite and sericitic phyllite overlying the surrounding granitic gneiss. The above sequence of rocks is well-exposed along the road section between Mundargi, Bagewadi and Balhatti, about 25 miles S.S.E. of Gadag town.

The graywacke schists are pale to dark greenish-grey, spotted schists-showing in thin sections angular to sub-angular grains of quartz, sericitised plagioclase felspar, cherty quartzite, altered greenstone and unidentifiable lithic fragments, set in a fine-textured schistose matrix of sericite and chlorite and silt-sized interstitial meal of quartz and felspar; the green chloritic phyllites are fine-grained phyllitic schists overlying the graywacke schists; the limestones occurring within the chlorite phyllites are thin-bedded, dark-grey and cherty, carrying cubes of pyrite; the ferruginous quartzites overlying the chloritic phyllites are banded hematite quartzites and cherts.

The occurrence of graywacke in the Gadag band in Mysore, hitherto unnoticed, may throw light on the stratigraphy, correlation and palaeogeography of the Dharwar rocks of South India. The association of greenstone, graywacke, chlorite schist, dark-grey cherty limestone and ferruginous chert indicates a "eugeosynclinal" facies of Stille and Kay, equivalent to "Graywacke (flysch)" suite of Pettijohn.

40. Newer Dolerites of Hirakud.

V. S. DUBEY and D. N. RATH, Varanasi.

The dolerites of Hirakud occur as dykes in the granites of Lachhmi Dungri and extend in a roughly N. W. to S. E. direction. These form discontinuous and broken up ridges. These are coarse to fine-grained in texture and sometimes exhibit pockets of quartz in addition to micropegmatites. Labradorites have been saussuritised to produce calcite and quartz and monoclinic pyroxenes show uralitisation giving distinct cleavages and extinction between 33°-48°. Quartz is found in association with the sericitised feldspars as micro pegmatites. The accessories include magnetite, ilmenite and apatite. The phenomena of uralitisation, saussuritisation and chloritisation are widely exhibited. These dolerites show free quartz and micropegmatite probably as a result of absorption of granitic material by the basic magma. The origin may be ascribed to magma injected along the fractures, which were widened by the pushing apart of the walls. The dolerites represent the last phase of igneous activity in the area and are intrusive into the granites. These are also found intrusive into the Cuddapahs of Chandli Dungri which indicate that they are post-Cuddapah in age.

41. Note on Magnetite-quartz rocks (Iron Ores) in Kozhikode and Palghat Districts, Kerala.

R. THIAGARAJAN, Calcutta.

The rock occurs in the form of thick bands with the biotite gneisses and other rocks of the region, form a conformable succession with them and show evidences of intense metamorphism and structure disturbances. The bands which form the Varakal hill, West hill and East hill near Kozhikode, together form a structural basin (doubly plunging syncline) while the two bands in Naduvallur form the nose of a syncline which plunges south-east. One of the two bands near Nilambur is the nose of an anticline which plunges south.

The bands are from twenty to hundred and fifty feet thick and extend in the direction of trend from 100 yards to half a mile. The rocks show, in general, considerable lateritisation but the bands near Kozhikode and Nilambur are quite fresh, and show little or no alteration. The rocks when fresh are of different shades of grey, tough, coarse to fine grain and granular in texture. A rude lamination is not uncommon in some of the occurrences when the individual layers are, on an average, ¼ to ⅛ inch in thickness.

Quartz and magnetite are the essential minerals of the rocks. Garnet and gruenerite occur in small portion in some of the bands. Magnetite often shows alteration to limonite. Percentage of magnetite in the rock ranges from 40·76 near Naduvallur to 62·77 near Nilambur. Detailed petrographic work on the rocks is in progress.

42. A Petrofabric Criterion for the replacement origin of Granitic Rocks.

AJIT KUMAR SAHA, Calcutta.

Statistical studies of quartz orientation in the granitic rocks and the associated metamorphites of Eastern Singhbhum and Mayurbhanj and also in Ontario, Canada, indicate that the following characteristic features are produced in the quartz fabric as a result of the granitization of a metamorphite :—

1. The original orientation pattern of the metamorphite tends to be retained, although the degree of preferred orientation is reduced appreciably, so as to become statistically *not significant* in some cases.

2. A tendency towards development of a peripheral *ab* girdle, in addition to the usual B-girdle, is evident in many cases, although the *ab* girdle is absent in a few areas of granitized rocks, such as in Manbhum and New South Wales.

Available evidences suggest that the *ab* girdle in the granitized rocks is a result of mimetic crystallization of the introduced quartz controlled by the foliation planes and that such girdles are more likely to be found, (a) where the replaced metamorphite had prominent partings along the foliation planes and (b) in rocks where the recrystallization was post-kinematic.

Presence of *ab* girdle, along with a poor preferred orientation of quartz, might be considered as a criterion for the replacement origin of granitic rocks.

43. A textural study of the newer Dolerites.

MIHIR KUMAR BOSE, Calcutta.

Textures in the Newer Dolerites occurring around Champua (22° 04′ :85° 40′), Hatgamariah (22° 16′ : 85° 45′) and Jagannathpur (22° 13′ : 85° 39′) have been studied and analysed Textural changes have been noticed with variations in grainsize.

In the relatively coarser bodies the texture is "doleritic" with remarkable growth anisotropism of pyroxene, and with a fall of idiomorphic crystallates towards margin. In finer grained bodies, variation in idiomorphism of pyroxene is indicated by an increase in the pyroxene ratio towards centre of the bodies. Granulophitic texture is occasionally developed in such rocks. In general the dominant texture in the rocks is subophitic though there are local development of ophitic or nesophitic pyroxene.

Plagioclase and pyroxene were among the earliest crystallates, the former very likely showed a slight lead and they crystallised in a ratio roughly 58 plagioclase to 42 pyroxene. Possible explanation for the textural variations have been furnished.

44. Petrography of the Gneissic Granites of Champua, Keonjhar, Orissa.

MIHIR KUMAR BOSE, Calcutta.

Around Champua (22° 04′ : 85° 40′) "microcline granites" (part of Singhbhum granite) are exposed against and within the older parametamorphics, with similar strike variations. The foliation which shows local small scale folds, is absent towards the periphery of the granite body and in pockets within the metamorphics, with increasing amount of microcline. The average composition on the basis of modal analysis, is bII P_5 though there is an actual transition from subclass 312 to 213, evidently due to replacement of plagioclase by microcline. Quartz occurs as drop-like inclusions in plagioclase (An_{14}) and as embeying grains. Plagioclase is often decalcified (An_4) along the margin, in contact with microline. Microline replaces plagioclase. Biotite ($\beta = 1{\cdot}628$) is often associated with sphene and epidote. Ilmenite shows calcification to sphene. The primary process in the emplacement was introduction of plagioclase, partly accompanied by deformation, this being followed by formation of microcline. Petrogenesis has been considered in the light of petrographic and field observations.

45. A note on the occurrence of a Tachylitic dyke in the Olivine-Gabbro porphyrite near the Sakkarbagh Zoo at Junagadh, Bombay.

A. K. PRASAD, Patna.

The author records, for the first time, the occurrence of a tachylitic dyke, about 8″ thick, cutting across the Olivine-Gabbro porphyrite which has also not been reported previously from this area. The dyke shows variolitic structure in the inner portion. Such tachylitic dykes have been reported from Arran in Scotland.

The petrography of the porphyrite has been worked out and effect of dyking on the gabbro, even in hand specimen is quite interesting. There has been clouding of the plagioclase laths, schillerization and a complete obliteration of zoning. The pyroxene also shows less competency, towards stress, probably due to the two sets of cleavages present. Secondary mineralisation of olivine, pyroxene, and glass has been predominant. Delessite, epidote, palagonite, and zoistite are common.

The author thinks that the tachylite may represent a chilled phase of the Deccan basalts and then the gabbro-porphyrite is definitely older in age.

46. Pegmatites of Tulin, Purulia Dist., West Bengal.

DILIP KUMAR SEN GUPTA, Kharagpur.

Pegmatites around Tulin (Lat. 23° 54′ N, Long. 85° 22′ E) Purulia Dist. West Bengal, occurring in the metamorphic migmatic and granitic gneisses, vary widely in shape and size, in internal structure and in their relation with the geometry of the host rock. They are formed essentially of quartz and felspar in variable proportions, sometimes showing excellent alignment of tabular felspars parallel to the boundary of the pegmatite bodies.

Some of the pegmatites are folded with the gneisses coaxially and are later cut obliquely by younger pegmatites with occasional offset, The nondilation pegmatites are very common in gneissic complex and are either conformable with the gneissic foliation or are discordant, having the relicts of the gneissose bandings passing undisturbed through them, indicating salient replacement. Dilation pegmatites with pinch and swell structure often have the foliation of the invaded rocks wrapping round them. Basic rims (chiefly biotite) occur in the borders of the concordant pegmatite veins. Ptygmatic veins are very common in both the migmatitic and metamorphic rocks, becoming more abundant with the narrowing of the veins.

Thus the pegmatites are as a whole late kinematic, attendant with the last phase of granitization.

47. Metamorphism of Dolerite around Galudih, Singhbhum, Bihar.

KSHITINDRAMOHAN NAHA, Kharagpur.

Metadolerites occurring in profusion in the Pre-Cambrian belt around Galudih 86° 25′ :22° 39′), Singhbhum, Bihar, are metamorphosed accordantly with the garnet- and staurolite-kyanite zone pelitic country rocks. They, however, do not follow the normal trend of metamorphism as laid down by Wiseman. Even in the staurolite-kyanite zone rocks, relict doleritic texture (with relict plagioclase laths, the pyroxenes having been transformed) is common in association with almost totally neocrystallized metadolerites made up of plagioclase, deep green hornblende, epidote-clinozoisite, quartz and sphene. The relict plagioclase laths in different stages of transformation are characterized by turbidity, zoning, and complex twinning on albite-Carlsbad, albite-ala B, Carlsbad, albite and pericline laws, with a large number of twin lamellae in each grain. The neocrystallized plagioclase grains in contrast are clear, equant, untwinned or twinned only on albite or pericline/acline law with few subindividuals.

The anorthite content of neocrystallized plagioclases in association with clinozoisite-epidote has been used for demarcating the metamorphic zones. Clinozoisite-epidote is in equilibrium with An_{13-28} in the garnet zone and with An_{28-46} in the staurolite-kyanite zone.

48. An amphibolite from the north fringe of Hazaribagh Plateau in the neighbourhood of Koderma, Bihar.

S. N. WAKHALOO, Patna.

Within the north fringe of Hazaribagh Plateau the metamorphic rocks which consists of schists and gneisses have been observed to contain intercalations of amphibolite, and the paper gives an account of the occurrence and mineralogy of this rock. The amphibolite is a medium grained granular rock or dark gray or black colour consisting largely of amphibole and plagioclase feldspar. Under the microscope pale green amphibole shows a great range in size; the larger crystals attain a length of 1·5 mm., and show porphyroblastic development with conspicuous poikilitic texture. The optical properties reveal it to be hornblende. Plagioclase is of the composition of Ab_{52} An_{48} and exists in xenoblastic grains with well developed twin lamellae after the albite law. The important accessory is iron ore which forms sporadic patches. The rock as such carries the critical mineral association of the amphibolite facies and lends support to the view that the region had been subjected to the high grade metamorphism of this facies.

49. A note on the Petrography of the Anorthosites of the Barabar hills, Gaya district, Bihar.

R. N. PRASAD, Patna.

Anorthosites are recorded as detached blocks on the lower reaches of the eastern flanks of the Barabar hills (Lat. 25° 1′; Long. 85° 3′). Due to differential weathering the exposed portion appears to be pitted. These compact and massive rocks are granulitic in texture and are coarse to fine grained. The segregations of dark minerals appear as clusters, thus giving rise to Glomeroporphyritic texture.

Predominant among the mineral constituents are the plagioclase ranging in composition from Labradorite to Bytownite. Among the dark minerals are Hornblende, Biotite, some altered Pyroxene, Sphene and Magnetite. The effect of cataclasis has induced peripheral granulation in the felspars resulting in pseudo-porphyritic texture. The ferro-magnesian minerals occur either in the interstices between the felspar grains or in clots. The microscopic characters are given in the body of the paper.

The rocks are generally even grained and lack banding or foliation. Except for the foliation, these are similar to the Anorthosites of Bankura district, West Bengal.

50. A Metamorphic Study of Chowkhutia Rocks, Dt. Almora, Uttar Pradesh.

S. B. KAR, Cuttack.

The geological succession of the area includes a series of phyllites (quartz-mylonites), chlorite schists, muscovite-biotite schists, and quartzites associated with gneissose granites. The calcareous rocks include massive limestones with purple and blotchy slates. The original sediments were regionally metamorphosed with the development of index minerals, characteristic of each event. This was followed by retrogression. During or after this stage basic igneous rocks in the forms of dykes and sills intruded, with an interval between them, and caused contact metamorphism. After this, again progressive metamorphism took place, followed by injection of acidic materials into the country rocks. During the last stage, shearing stresses and tectonic disturbances facilitated the development of cataclastic zones. The recrystallisation was so intense that the original textures and structures were completely lost and new ones developed.

51. Distribution of Granites and Sedimentaries around Jabalpur, M.P.

M. G. PAITHANKAR, S. C. VARMA, W. N. BANSODE, Jabalpur.

The sedimentaries comprise of the Jabalpur beds of the Upper Gondwana period conformably succeeded by the Lametas. The Deccan Trops overlie the Lametas. So there was a period of practically continuous deposition commencing from the beginning of the Jabalpur period to the end of the Lameta.

For granites are gneissic in character, of Archaen age, and occur in two main groups of ridges, (i) Northern Group, which may be called as the Gokalpur-Ghamapur granites and (ii) Southern Group, which may be called as the Madan Mahal granites. The granite of both the groups is similar.

These two blocks of granites are separated from each other by the intervening sedimentaries. Granite inliers are seen wherever the sedimentaries were thin and as such have been eroded away. Further the Madan Mahal granites are surrounded on the north, south and east by the sedimentaries. Such a field relationship of the granites and the sedimentaries means that the two granite blocks must have been separate even before the deposition of the Jabalpur beds.

It is concluded that the Gokalpur-Ghamapur granites and the Madan Mahal granites were originally continuous and connected, but sometimes during the pre-Jabalpur times block faulting took place in the granites and the central portion was laid down separating the two granite blocks. The boundary between the granites and the Jabalpur is a faulted one and that the Madan Mahal granites are bound by faults both on the north and the south, the downthrow of each being due north and due south respectively. Along the faulted boundary between the granites and sedimentaries big lakes are present.

So the Madan Mahal granites represent a horst or a block mountain and the intervening country between the two granite blocks represents a faulted basin into which the sedimentaries have been deposited.

51a. A note on the occurrence of Molybdenite in Bundelkhand Granite in Jhansi District, Uttar Pradesh.

A. G. JHINGRAN, S. N. PURI, R. S. SHARMA, and P. C. MATHUR, Calcutta.

The paper records for the first time the presence of small segregations of molybdenite in the Bundelkhand granite near Saprar Dam (25° 12′ 30″ : 73° 7′ 30″, topo. sheet No. 54 0/4) in the Jhansi district, U.P. A mineralogical account along with a petrographic description of the country rock has been given and the genesis discussed. This mineral is usually associated with acid igneous activity, and occurs either in the acid igneous rocks themselves or in their close proximity, forming replacement deposits. In either case a primary magma is inherently involved. It is accordingly inferred that a magma from the deep magmatic chamber must have been associated in its deposition.

(iv) Sedimentology

52. Sedimentology of the Jabalpur Series of Rocks, Jabalpur District.

M. SRIRAMA RAO, Jabalpur.

The Jabalpur Series of rocks of Upper Gondwana age comprise sandstones, clays and gritty shales. The sandstones show current bedding, are brownish in colour being somewhat ferruginous and, in places, micaceous and felspathic and can more appropriately be referred to as greywackes. They exhibit considerably variation in grain size and shape as also in degree of cementation. The clays and gritty shales are whitish, buff or grey in colour, all the beds being nearly horizontal.

The sandstones have a heavy mineral assemblage which is rich and varied. It includes magnetite, hematite, tourmaline, ilmenite, rutile, kyanite, epidote, glaucophane, hornblende, anatase and sillimanite besides a few less important minerals which indicate a provenance of acid and basic igneous rocks in addition to glaucophane-bearing schists and other metamorphic and metasomatic rocks.

The rarity of well-rounded grains of sand, the low sphericity values and the relatively perfect crystal outlines shown by tourmaline, rutile etc., indicate the site of deposition to have been not far away from the provenance. Very frequent alternations of coarse and fine-grained rocks, partial distribution of heavy minerals in a single rock, wide variation in the degree of induration and in the amount of cementing material are all features which establish the fluviatile nature of the sediments. Post-depositional changes include block faulting of the beds into lower levels.

53. Mechanical analysis of Barakar and Talchir Sandstones from Rampur Coalfield, Sambalpur District, Orissa.

BANKIM MUKHERJEE and APURBA KANTA CHOUDHURY, Calcutta.

The Barakar and the Talchir sandstones occurring in the Rampur Coalfield (Lat. 21° 45′ N—21° 52′ N and Long. 83° 53′ E—83° 59′ E), Sambalpur district, were sampled regularly along strike to bring out significant variation in size parameters in time and space. The results obtained from several mechanical analysis are graphically represented by histograms and cumulative curves. Histograms are unimodal. From the cumulative curve the various measures like median, quartile deviation and the values of sorting index were determined. In Barakar sandstones the sorting index varies from 1·30 to 1·70 and in Talchirs from 1·35 to 1·40, showing that the sediments are well sorted. The value of skewness is positive, which shows that the coarse admixtures are greater than the finer sediments. From the frequency curves, arithmetic mean diameter and mean deviation were calculated. The deviation was considerable. The Baker's Grading Factor (G.F.) determined from the above also corroborated the findings that the sediments are imperfectly graded.

54. Heavy mineral frequency in different size grades of sediments.

C. N. RAO and S. V. L. RAO, Kharagpur.

Heavy minerals are generally found in medium to fine sand size grades. The factors responsible for the variation in different size grades is not understood fully. The available data on the heavy mineral frequencies of the Talchir sandstones from Burahai and adjoining basins have been considered at length. From this data, the following conclusions are apparent :

(1) Antepathetic relation between mean size (0·1—0·25 mm.) and total frequency.

(2) Antepathetic relationship between garnet and hornblende.

(3) Sympathetic relationship between hornblende, magnetite and sphene.

The factors responsible for the variation in the mineral frequencies with reference to their size are many, such as variation in hydraulic conditions, hydraulic equivalent, size of different minerals and the relative availability of different size grades of minerals. The variation in the mineral frequencies of garnet and hornblende indicates the current direction. The variation in the mineral frequencies of magnetite and sphene possibly indicates slight turbulence in the depositional environment.

55. Study of Tourmalines from pebbles of Banganapally conglomerate around Kalava, Kurnool District.

T. C. BAGCHI and K. V. G. K. GOKHALE, Kharagpur.

The sequence of rocks of Kurnool system, in the area around Kalava (15° 37′; 78° 12′) starts with a basal conglomerate succeeded by orthoquartzite—limestone faceis having a strong resemblance to the standard sequence of typical foreland faceis. The occurrence of different types of tourmaline with authigenic growths in the Banganapally stage has been reported, earlier by the authors. The present paper deals with the detailed optical characters of all the varieties of tourmaline (Elbaite, Fe-schorlite, indicolite, Mg-Fe scholite, Fe-dravite, Li-rubellite, Cr. tourmaline, Na-dravite) in the pebbles of the Banganapally conglomerate.

Authigenic intergrowths, colourless to pale blue in colour, have been noticed at one end of the C—axis of the grains of all the varieties. Between the outgrowth and the nucleus is a zone of roots or reorganisation where the core and the outgrowth are welded together. At places the overgrowth is broken off and the pitted surface remains at one end of C—axis, as an evidence of its former existence.

The presence of tourmalines of various shades seem to indicate that the importance of acid intrusive material as source rock, should not be underestimated. The study of tourmalines along with the other heavy minerals, suggests that the source of rocks are derived, perhaps, partly from the reworked older sediments and partly from the Dharwarian metamorphites; as is also evidenced from the presence of fragments of shale in the conglomerate.

56. Core Library.

A. K. MUKHERJEE, Calcutta.

The idea of setting up a Core library is quite new in India. With the progress in the method of mineral exploration by drilling the problem of manufacturing a complete record of the bore hole data and preserving the cores for future reference and correlation of structures and formations has come to the forefront. Whether it is drilling for assessing the reserves of coal and other minerals or only to see the extent of a particular structure, the cores may give indication to other valuable information of the formations below. Preservations of core and bore hole data has been emphasised under rules 18 and 19 of the Mineral Conservation and Development Rules, 1958 but the best way to maintain a permanent record will be to establish a Core Library in India which will be the first of its kind not only in India but perhaps in Asia. The cores, bore hole data, analyses and other details will be maintained 'mineral-wise' and 'district-wise' as far as possible. Such a core library will facilitate the research work and will help to find out the correlation of different mineralised provinces.

57. The study of the sea floor sediments of Visakhapatnam Coast.

V. VENKATARATNAM, M POORNACHANDRA RAO and C. MAHADEVAN, Waltair.

The systematic study of sea floor sediments along with other branches of Oceanography has been started since 1952—'53 at the Andhra University. The sea floor sediments from the continental shelf of Visakhapatnam coast (Lat. 17° N & 18° N and Long. 82° 15·5′ E & 84° E) are studied with regard to mechanical composition, constituents of "Coarse fraction" (i.e. coarser than 0 062 mm. size), detrital minerals and shape of quartz grains.

As a result of quantitative studies, it is revealed that the Zonal classification of sediments, made earlier, holds good. There is an increase in foraminiferal number and in the proportion of globigernia to other ormaminifera with increase in depth from shore towards the continental shelf. The distribution of detrital minerals like Garnet, Sillimanite and the attributes of quartz such as elongation and wavy extinction point to a provenance dominated by metamorphic rocks. The sphericity of quartz grains throws some light on the similarity of nature of sediments at depths of 12 fathoms and 41 fathoms.

58. Unique size-roundness relation in the Clastic Grains of the Barakar Sandstones of South Karanpura Coalfield.

INDRANIL BANERJEE, Calcutta.

The petrographic study of the Barakar sandstones of the above area has revealed a highly significant negative correlation between size and roundness of the clastic grains. This has been revealed by visual estimation measurements in 12 samples and Wadell method measurements in one individual spot sample and one composite sample homogenized from 6 texturally dissimilar spot samples from different parts of the Barakar formation.

Such inverse relation of roundness-increase with size-decrease cannot be explained by the mechanics of ordinary fluvial transport. It can only be explained by presence of second-cycle sediments in the finer grades. Hence the sediment has dual source. One of the two components is, an assemblage of coarse angular grains freshly derived from a near source of an acid igneous rock, the other component being finer and more rounded grains derived from a mature pre-existing sedimentary rock. As the contribution of finer and more rounded grains progressively increases in the finer grades, the over-all roundness will also increase in the finer sizes.

The above postulate of dual source is corroborated by the presence of two contrasted types of sedimentation units, one ill-stratified, ill-sorted and coarse-grained, with much felspar and the other well-stratified, well-sorted and fine grained. Another evidence is presence of rounded Zircons and tourmalines in the finer size grades suggesting presence of a second cycle sediment.

59. Heavy mineral variation in the Talchir Sandstones of Burhai Basin.

M. N. MAHAPATRA, K. C. MISRA and C. NARASIMHA RAO, Kharagpur.

The paper presents the results of heavy mineral analysis of the sandstones belonging to the Talchir stage near village Burhai (24° 21·5′ N, 86° 33·5′ E), Santhal Pargana District, Bihar. The three chief petrological types, namely, the boulder conglomerates, the mauve sandstones and the chloritic arkoses in order of their antiquity consist of almost identical suites of heavy minerals. Garnet of different colours predominates in all the three horizons with an average of 40 per cent. In order of decreasing abundance the following minerals have been identified —Hornblende, Sphene, Tourmaline, Magnetite, Zircon, Epidote and Staurolite.

A comprehensive heavy mineral diagram drawn for all these rock types shows a progressive increase in the percentage of Garnet, while Hornblende & Magnetite decrease in percentage towards the top. The rest are more or less uniformly distributed.

The heavy mineral assemblages do not show any wide departure up the sequence and the almost identical character of the heavy mineral suites in all the three stages, show that the sequence is a conformable one.

60. Preparation of artificial silt for tracer studies near Bombay Harbour.

A. C. EAPEN, N. G. S. GOPAL, V. K. IYA and T. P. SARMA, Trombay, Bombay.

Important dredging operations will soon have to be undertaken in Bombay Harbour and it is essential for this purpose to know that the dredged mud from the selected dumping grounds will not return to the harbour itself. It was hence decided recently to carry out a tracer study of the bed movement of silt at the selected dumping site, North West off Malabar point. The experiment will be carried out jointly by Isotope Division, A.E.E.T., Central Water & Power Research Station, Poona, Bombay Port Trust, and Hydraulics Research Station, Wallingford, next January.

This paper gives an account of the preparation of an artificial silt which must resemble closely the natural silt in its size distribution and density. Such a silt will then be activated in a reactor and used as a tracer, Scandium-46 will be the tracer element and the gamma rays emitted will be detected by an under-water Gieger Counter assembly.

The preparation of an artificial silt with the requisite hydraulic properties involves firstly a precise determination of the particle size distribution of the natural silt both in the dispersed and flocculated states. A curve between these two valves is taken for the proposed grading for the artificial silt. Scandium Oxide is introduced into boron-free glass of appropriate composition so that the density of the final material is approximately that of the dried harbour mud. The glass is then crushed by suitable techniques and from the crushed powder, an artificial silt whose size distribution curve approximates to the proposed grading curve is prepared.

61. Size Distribution in the materials of Neyveli Groundwater Reservoir, South Arcot District, Madras State.

R. VENKATARAMAN, Calcutta.

The paper deals with the results of sieve analysis of about 800 samples of materials of First, Second and Third aquifers constituting the Neyveli Groundwater Reservior. The samples of materials of different aquifers were collected mainly for use in determining the screen sizes and the sizes of materials for gravel packs. The data of sieve analysis of these materials have been subjected to a systamatic study. Statistical techniques have been applied in the interpretation of the data in order to make a comparative study of the size frequency distribution in the materials of the three different aquifers. While the study has shown some similarities amongst the materials of the three aquifers it has also drawn attention to the dissimilarities in the degree of dispersion, degree of sorting and in the skewness in the materials of the three aquifers. It has also revealed the considerable lateral and vertical variations in the materials of the different aquifers even within a limited area. Attention has also been drawn to the impplications of such variations in the materials of the aquifers.

(v) Economic Geology

62. Microscopic characters of placer sand deposits in the neighbourhood of Cape Comorin, South India.

S. DEB, Calcutta.

Extensive beach placer deposits of voluminous accumulation in sands, occur along the Malabar and Coromandal coast, extending along the west coast in intermittent patches from the neighbourhood of Cape Comorin through Kerala and Malabar sea beaches towards the Gujrat coast.

On the east coast of India, isolatetd patches of beach placer deposits are known in several localities of Madras State and Andhra Pradesh which extends up to Orissa.

In the neighbourhood of Cape Comorin, three different kinds of beach sands occur. Usually sands collected from the extreme southern point of the Cape, appear to be colourless with more or less minimum concentration of heavy minerals. Sands occurring on the eastern side of the region, are of pink colour and contain innumerable grains of pink garnet and a minor amount of zircon. The heavy fraction of the east contains an insignificant amount of monazite, ilmenite, rutile and magnetite. Sillimanite appears to be very rare in the sands of the area.

On the other hand, sands from the western side of the Cape, contain too many heavies, such as ilmenite, garnet, zircon, and monazite with an insignificant amount of rutile and magnetite.

It has been found that the frequency of zircon increases where garnet predominates.

Separation of heavy minerals by bromoform and by a powerful electro-magnet have been done in the laboratory. The ferro-magnetic, para-magnetic and dia-magnetic fractions have been separated from different sand samples collected from the different areas of the cape.

The opaque minerals are mostly ilmenite, rutile and a few grains of magnetite. The polished surfaces of ilmenite are often leucoxinised whereas some of the magnetite grains have been altered to martite and then to goethite.

The non-opaque minerals are mostly garnet, zircon, monazite and sillimanite (rare). A quantitative estimation of these heavy minerals and their frequency have been determined by an electrical point counter.

It is evident from the detailed study of these placer sands that most of the minerals are very resistant and could withstand the action of sea-waves through ages but most of the opaque minerals are slightly altered and not entirely decomposed.

63. Kyanite Deposit near Ghatsila, Dt. Singhbhum, Bihar.

T. C. BAGCHI, Kharagpur.

A small deposit of kyanite in a dome shaped hill of quartz-kyanite granulite is situated nearly a mile and half off Ghatsila, Dt. Singhbhum, Bihar. Kyanite has segregated in nests, pockets, and lenses in quartz veins injected lit-par-lit into or cutting across the quartz-kyanite-granulite rock; kyanite has also been concentrated in the wall rock along the immediate contact of quartz veins. Detailed study of the kyanite occurrence indicates that lenses of highly aluminous siliceous sediments, on metamorphism gave rise to quartz-kyanite granulite into which were injected solutions derived from the adjacent Mosabani granite. The segregation of kyanite in sufficient concentration in the quartz veins is believed to be due to the resorting of aluminous material by the solutions from the host quartz-kyanite granulitic rock.

64. Hydrothermal alterations in the ultrabasics of Jojohatu area, Singhbhum Dist.

KRISHNA KANT SINGH, Kharagpur.

The processes of hydrothermal alteration of the ultrabasic rocks around Jojohatu area, Singhbhum district, can be broadly divided into six types: (1) serpentinization, (2) bastitization, (3) steatitization, (4) amphibolization, (5) dolomitization and (6) chertification

Serpentinization is very closely related to mass alteration of the ultrabasic body both during and after emplacement. As a part of the serpentinization, bastitization appears to be more commonly associated with pyroxenites. The serpentines, the end products of this process, are generally a natural mixture of chrysotile and antigorite. Antigorite is formed by the mass serpentinization of olivine bearing ultrabasics. On the other hand, chrysotile appears to favour zones of weakness like faults, joints, sheared belts and zones of chromite mineralization. It is possible to recognise 3 minor stages in the formatiton of chrysotile based on the cross-cutting relations. During this process, iron ore has been released.

Steatitization is usually noticed at the peripheral zones where the hydrothermal phase contains greater amounts of silica than in the former case. If calcium is available, at higher temperatures, amphibolization is favoured. Dolomitization is a replacement phenomenon usually associated with steatite. Carbon dioxide metasomatism is a deep seated one as evidenced by the association of copper and lead ores in minor amounts. There is a wide spread chertification in the whole region, the silica being partly derived from the ultrabasics and in part from the country rocks. The bearing of these processes on the economics of chromite deposits is analysed.

65. Ore-microscopic studies of the Manganese ore-minerals of Sitasongi and Chikhla, Bhandra District, Bombay (old Madhya Pradesh).

S. P. DESHPANDE, Nagpur.

The paper gives an account of the ore-microscopic study of the manganese ore-minerals collected from Sitasaongi and Chikhla manganese mines in Bhandara District, Bombay State (Old M.P.). A short account of the geology of the area is followed by the mineralogy of the ores The following are the ore-minerals that have been identified in polished sections :—Braunite, Sitaparite, Jacobsite, Pyrolusite, and Psilomelane. The characters of these ore-minerals under reflected light are given along with their etch reactions and reflectivity values. In addition, a mineral showing properties different from those shown by any known manganese ore-mineral has been described. The identity of this mineral can only be established on chemical and X-ray studies which are now in progress. Interesting textural features, such as the Braunite-Sitaparite intergrowth, oriented replacement of Jacobsite by Hematite, mutual boundary relationship shown by certain minerals etc., have been fully described. The mineral paragenesis, based on textural features, was found out to be as follows : Sitaparite, Hollandite, Braunite (in part), Jacobsite, the Unidentified mineral, Braunite (in part) Psilomelane, Hematite and Pyrolusite.

66. The clay deposits of Sihora Tahsil in Jabalpur District, M.P.

V. S. DUBEY and UMA SHANKER, Varanasi.

A bed of clay has been located in small hills at Agaria and Jeti at a distance of about 20 miles from Sihora which is situated at railway station between Katni and Jabalpur on the Central railway of M.P. The clay bed occurs at a depth of about 30 to 40 ft. below the surface, and is overlain by banded hematite quartzite. The D.T.T. and X-ray studies show that it is Kaolinitic in nature. Its chemical analysis shows that it contains 60·2% of silica, therefore it is siliceous in nature. Its suspensibility in the raw stage and firing behaviour, shrinkage, porosity and tensile strength at various temperatures have also been determined. Microscopic study and refractive index determination of clay matter and its impurities has also been studied. The clay get vitrified at 1500°C. Different body mixtures for various pottery goods were made and the clay was found to be suitable for use in pottery industry and arguments have been put forward for the origin of this clay.

67. A Note on the Geology and Origin of the Rajgarh Emerald Deposit, Ajmer, Rajasthan.

S. K. BOSE, Calcutta.

The Rajgarh emerald mine lies in Rajgarh-Chat-Bithur emerald bearing zone, about 15 miles south of Ajmer, which forms a part of the 125 miles long NNE-SSW trending Ajmer-Merwara-Mewar emerald belt.

The emerald deposit of this area is found in rocks of the Delhi System comprising biotite schists, talc-schists, actinolite schists and phyllites traversed by pegmatites, vein quartz and tourmaline bearing granites which have caused widespread silicification and tourmalinisation.

The mineralised emerald zone which is at present being worked is nearly 600 feet long and is localised in 5 small hillocks. Hexagonal crystals* varying in length from fraction of an inch up to 5 inches of anhedral grains of emerald occur in pockets or sparsely disseminated, mostly in highly folded and contorted talcose-biotite-schist and rarely in actinolite schist near the border of tourmaline bearing pegmatites rich in beryl. Xenoliths of schists are also seen in the pegmatite. The green colour in the emerald, due to chromium, is probably from the peridotites. Altered peridotites occur near the contact of the pegmatites at the eastern part of the emerlad bearing ridge.

It appears that beryllium-rich solutions from the main pegmatite body have penetrated along structurally weak planes in schists, which have been replaced by emerald, tourmaline and rarely apatite.

68. A Note on the possibilities of finding Nickel-ore deposits in India.

SAILES C. CHAKRAVARTY, Calcutta.

No workable deposits of Nickel ore has been located in India so far. The paper describes briefly the known occurrences of Nickel in India.

Nickel with its identical ionic radius and ionic charge can diadochically replace magnesium in some minerals, like olivine, pyroxenes, in rocks formed during the differentiation of an original magma of basaltic composition. The amount of nickel, which is of a high order in the early formed rocks, decreases progressively in the sequence of differentiation and tends to rise again in the later formed acid differentiates. Sometimes, nickel may be associated with the hydrothermal stage, when instead of substituting for Mg, it forms 'complexes'. Depending upon the concentration of nickel ions in the original melt, nickel may form independent minerals or may get incorporated in the early formed magnesian minerals. As ore minerals, nickel is found in the sulphides which form at a later stage than olivine, chromite, titanite, and magnetite, being separated from the magma in the form of pyrrhotite-pentlandite deposits. Nickel is found in the hydrolysates, and other sediments which are derived from the weathering and denudation of rocks containing nickel bearing minerals. Under these circumstances nickel may get incorporated in clays and chlorites, besides occurring as 'solid' products of disintegration.

There are several ophiolitic belts in India, e.g., in the Andaman islands, and Manipur. It is suggested that these be investigated in detail for secondary nickel ores.

Such occurrences find an analogy with those in Cuba, Brazil, and the Philippines.

69. Economic aspect of Asbestos in Bihar.

S. N. P. SRIVASTAVA, Calcutta.

During investigations of asbestos in different parts of Bihar, it was found that the asbestos is confined to Singhbhum district including the merged portions of the former district of Manbhum. The asbestos is mostly of the amphibole (tremolite) variety, though chrysotile variety also is not rare. It is associated with highly altered or serpentinised ultrabasic or basic rocks. The probable reserves of thirty two localities are of the order of over three and a half lakh tons, varying in depths between 20 to 100 feet. Physico-chemical tests of thirty three representative specimens of asbestos from different localities, show that most of these are resistant to acids, alkalies and heat (at 800°C). The asbestos can, therefore, be used for asbestos cements, filters, laboratory boards, electric insulators etc., where high degree of resistance to acid and heat is required. All the deposits lie within a distance of twenty miles from the nearest railway stations or from good motorable roads. Therefore, a factory for asbestos cement products along with insulating materials etc., may be set up in Singhbhum district at a suitable place to supply the additional requirements of the country.

70. Some new occurrences of Vanadium in Sarjori area, Singhbhum District, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

While carrying out the investigations for asbestos in Bihar, occurrences of vanaduim-bearing iron ore were noted by the author at two places, on the eastern flank of the Pora Pahar, lying west of the village Sarjori (22° 32′ : 68° 20′) in Singhbhum district, Bihar. The iron-ore occurs discontinuously in a belt which is about a mile and a half long and about a quarter of a mile wide and runs north-north-east along the slope of the hill. Iron-ore occurs in pyroxenite which is altered partly and in places wholly to serpentine, talc and tremolite. The strike of the formation is also north-north-east to south-south-west. The exposed depth of the iron-ore is more than 30 feet in one of the trenches. The chemical analyses of two specimens from each of the two localities show 1 62 and 1·16 per cent of $V205$ and 54 44 and 56 40% Fe contents, respectively. Chromium and titanium, (the latter in one specimen) has also been noted. These occurrences had not been recorded so far. In view of the high vanadium content these deposits, and the adjacent areas should be thoroughly prospected.

71. Localisation of Manganese ore deposits in the Sausar Series, Madhya Pradesh and adjacent parts of Bombay.

S. C. CHAKRAVARTY and V. VENKATESH, Calcutta.

The manganese-ore deposits of Madhya Pradesh occur generally as steep to moderate dipping, bedded, meta-sedimentary syngenetic deposits, locally called 'reefs", as well as their associated supergene enrichments, and also as transported weathering products, known as "boulder ore".

The reefs are tabular conformable beds and lenses following the strike of the enclosing host rocks, and occupy three general stratigraphic positions—the Lohangi horizon at the base of the Mansar stage, the Mansar horizon at two or more stratigraphic position with the Mansars, and the Chorbaoli horizon between the Mansar and Chorbaoli stages. The major producing deposits are, however, restricted to the Lohangi horizon, at the base of the Mansar stage. The ore deposits consist of primary bedded braunite-quartzites, gondites and their superficial weathering products. The ore bodies increase in thickness due to tight internal folding. Primary oxide deposits have been proved to vertical depths of over 600 feet.

Detailed studies of various deposits in the area indicate that folding has been responsible for localization of large ore-bodies. The manganiferous beds at Kandri, Chikla, Sitasaongi and other places thicken and get localized in troughs and crests of the isoclinal synclines and anticlines, the pitch of the ore bodies being parallel to the plunge of the folds. Localization of ore is also noticed in drag folds along the limbs of folds as at Mansar, Chikla extension and Bharweli-Ukwa, and in tight recumbent folds as at Tirpodi. The distribution of major ore bodies as distinct groups in different localities along the belt and the impersistent gonditic nature of those in-between, suggest deposition of manganiferous beds in disconnected basins.

Plastic deformation has played an important part in the early stages causing thickening of the manganiferous beds, before their conversion into more competent manganiferous quartzite by metamorphism. Relative competence of these at later stages in relation to the surrounding less competent schists was responsible for preserving the large ore bodies in folded areas.

72. Structural Control of Pyrite Mineralization at Ingaldhal in Chitaldrug Schist Belt, Mysore.

N. A. VEMBAN, Calcutta.

The Precambrian Dharwar metavolcanics and associated metasediments of Ingaldhal pyrite area in Chitaldrug Schist Belt are grouped lithologically into three zones from west to east : 1. Pillow lavas with a network of intimately penetrated diabase dykes forming the eastern side of Jogimaradi Hill, 2. Massive, foliated and schistose greenstones with associated banded ferruginous chert of Bellingudda range, and 3 Chlorite schist with associated pebble beds of Doddasiddavanahalli-Kyadigere plain country. These rocks are penetrated by later dolerite, felsite, granite, aplite and vein quartz.

The regional trend of rocks is north-south with steep dips dominantly towards west. North-westerly *'en echelon'* faults are common.

Pyrite mineralization is confined to the ferruginous chert on the eastern flank of the Belligudda anticline, and is specially pronounced where the chert is intersected by *'en echelon'* faults. This is also excellently brought out by the distribution of geophysical (self potential) negative anomalies all along the hill range obtained by previous geophysical surveys. The ore bearing solutions have apparently followed the *'en-echelon'* faults in the anticline, and mineralized the banded ferruginous chert zones which appear to have been the most favourable host rock for metallization.

Pyrite is the most important sulphide in the mineralized zones, but some copper mineralization is seen in a few chert bands on the western flank of the Belligudda hill, suggesting a hydrothermal zoning. Detailed mineralogical studies of the sulphide ores are progressing.

73. Structural control of manganese-ore deposits in Vizagapatam Manganese Belt, Andhra Pradesh.

G. V. RAO, Calcutta.

Detailed structural mapping of parts of the Vizagapatam manganese belt in Srikakulam district, Andhra Pradesh, has brought to light certain definite structural controls which have a great application in the future exploration and mining of the deposits. The manganese-ore deposits are confined to garnetiferous quartzite and garnet granulites, referred to by Fermor as "Kodurites", associated with coarse grained quartzites, crystalline limestones and calc-silicate granulites and gneisses, traversing through garnet-sillimanite gneisses (khondalites), charnockitic gneisses, biotite gneisses, granite gneisses and intrusive ortho-gneisses and granites. The regional strike of the rocks is N.W.—S.E. to N.N.W.—S.S.E. Opposing N.E. and S.W. regional dips across the strike of the rock formations and repetition of the quartzites, calc-gneiss garnet-sillimanite gneisses etc., indicate an earlier folding about a N.W.—S.E. axis, plunging towards south-east. The swerving of regional strike to N.E.—S.W. suggests a later cross folding of the formations about a N.N.W.—S.S.E. or N.—S. axial trend.

The manganese-ore deposits are localised in areas of intense drag folding along garnetiferous quartzites and granulites, the pitch of the ore bodies, which is on an average about 30° to the south-east, is parallel to the plunge of drag folds and three regional plunge of major folds in the area. The ore deposits are mainly psilomelane—pyrolusite type oxides and wad, derived by supergene oxidation and enrichment of manganese garnet spandite. Primary braunite, vredenburgite, jacobsite and other minerals are developed in the vicinity of pegmatite and quartz veins cutting through the original manganiferous horizon. The mining of the ore bodies indicates that the depth of oxidation is shallow and the ore deposits have no great vertical extension.

74. Further occurrences of Magnesite in Almora district, U.P.

M. R. SUBRAMANYAM and R. S. JAIN, Calcutta.

While mapping in the Almora district a few interesting occurrences of magnesite near Bauri (29° 44′ 20″ : 79° 48′ 30″), hitherto unrecorded, were met with. Magnesite occurrences near Gerechhina and Dewaldhar have already been reported by the Geological Survey of India and are now being proved by the Indian Bureau of Mines. It is felt that these deposits may prove to be more extensive than those of Gerechhina.

Seven isolated lens-like zones of Magnesite are noticed in the dolomites and limestones. One just south of Bauri is exposed over a length of 1200 feet and width of 400 feet; some others measure 100 feet by 50 feet on the surface Other occurrences are near Bajaisya, Bagoikhan, Khardli Tok, and Asaun. The magnesite is coarsely crystalline, bladed to reticulated and occasionally radiating, and of yellowish to greyish colour. Huge boulders of magnesite are scattered over the area; no regular bedding on banding is seen.

The different occurrents have a general east-west trend and dips appear to be 30°-40° to the north. It is possible that all these occurrences may represent a single magnesite horizon exposed discontinuously from Gerechhina to beyond Dhuraphat.

75. Manganese deposits of Rajasthan.

V. S. DUBEY and R. M. SINGH, Banaras.

This area lies in Kushalgarh Tehsil, District Banswara, Rajasthan and is about 41 miles from Dohad in the North direction.

The ore is mainly Pyrolusite which is massive, hard and compact, at places acicular and radiate. A little Braunite and Psilomelane is also found, but the main bulk of the output is Pyrolusite.

The belt is exposed for 13 miles in Rajasthan and continued in Madhya Bharat U.P. to Jhabua district; the whole length being about 40 miles. It is a sedimentary deposit interbedded mostly with Phyllite. The thickness of the ore-band varies from ½″ to 4″ and the number of beds is about 4. The general strike of the bed is NW—SE; while the dip is towards SW, its amount varies from 42° to 72°.

Throughout the whole belt two zones can very well be marked, the North Eastern side of the belt is high grade zone and the South West is occupied by low grade zone. It appears that this belt represents a limb of the syncline whose axis runs in the NW—SE direction pitching towards SE and the other limb of the syncline is represented by the Manganese belt of Pani mines; both being the part of the same sedimentary bed which has been folded forming a syncline and thus the outcrops of the bed are found in two areas. The distance between these two limbs of the syncline is more than 50 miles and the intervening country is mostly covered by phyllites. The possibility is that this belt goes down to a great depth and it also thickens. Sometimes a very heavy and close folding of this belt has given rise to a zone of rich deposits of this Manganese ore.

76. Study of the coals from Bachra area, Ranchi District, North Karanpura Coalfields, with special reference to their chemical and petrological characters and their correlation.

BANKIM MUKHERJEE and JAYANTA DATTA, Calcutta.

In Bachra area, Ranchi district (Lat. 23° 40′ 50″—23° 43′ and Long. 85° 2′—85° 5′) N. Karanpura coalfields, several coal seams are met with striking NE—SW. According to the places of mining, the seams are locally named, from NE to SW—Bishujhapa, Ray, Churi, Manki I and Manki II. There are associated fireclay beds of good quality overlying the coals. The coals are all banded bituminous, friable with extensive fracture and cleats along which are developed pyrite and siderite.

Systematically collected samples of coals from all the seams are subjected to proximate and petrological analyses. The coals are all high in moisture (8-11%) and volatile matter content and are non-caking and non-swelling type. Sulphur content varies between 0.39-0.81%. Vitrains of these coals also do not show any marked coaking and swelling properties. Macerals present are Vitrinite, Fusinite, Semi-fusinite, Exinite, Micrinite, Resinite and Sclerotinite. A quantitative determination of the petrological components are made and the macerals are classfied into three main groups—Vitrinite, Exinite and Inertinite. The proximate and petrological analyses show similar values for Ray and Bishujhapa coals in one hand and for Manki and Churi coals on the other, while these values differ markedly between the two groups. The high percentage of Inertinite is significant, as the coals are all non-caking and non-swelling.

From the field observations and the analyses, it is concluded that in this area there are two coal seams—Ray and Bishujhapa being the one (Upper) seam and Churi and Manki being the other (lower) seam.

77. Differentiation of Sulphides on the basis of Lattice energy principles.

AMITAVA DUTT, Giridih.

A study of differentiation of sulphides requires knowledge of the stabilities of minerals. A mineral is stable when it has the highest lattice energy and lowest free energy. In sulphides the main type of bond is homopolar with partial ionic and much less metallic type. The principal contributor to lattice energy of an ionic structure is the energy of attraction usually expressed as product of opposite charges, square of electronic charges and Madelubg constant divided by interionic distance. The relation suggests that the energy and thus the stability will be high with high valence and low radii. Since the ionic and homopolar bonds are very closely related the principles of lattice energy for ionic compound were tentatively applied in the present qualitative study.

Relative heat capacities of minerals, whose relation with lattice energy have been discussed in the original paper have been applied with sufficient caution wherever possible to support and interpret our observations.

The conclusions drawn in part II confirm the trend of formations of sulphides expected on the above basis, suggesting ionic behaviour of the sulphides.

II

The stability fields of the following systems have been analysed : Cu-Fe-S, Pm-Zn-S, Fe-Ni-S, Pb-Sb-S, Fe-Zn-S, Cu-Sb-S. The following observations were made :

(1) In a system of sulphides cooling from high to low temperature, the stable mineral to form first has higher valencies and lower radii (high valence-radius ratio) than the rest.

(2) Intermediate stages follow with the participation of the cation next in order and are marked by progressive replacement of the former by the latter.

(3) This order guides the rest.

(4) Minerals of cations of identical valence and radii are contemporaneous. Their priority follows relative concentrations.

(4) The normal sequence may be completely upset under high partial pressure.

These observations help in grouping sulphides of the following to show their order of formation (in normal pressure, identical concentration and solutions favouring primary ores).

I. [Ruthenium, Iridium, Osmium, Rhodium, Chromium], [Molybdenum Stannum, Wolfram. Arsenic].
II. [Nickel, Iron, Cobalt, Zinc].
III. Antimony, Manganese, Bismuth [Copper, Cadmium], Calcium.
IV. Mercury, Lead, Silver

As a guide in ore prospecting the principle helps to construct preceding and successive stages and the phase rule (phase = component—mobility) predicts the exact number of minerals at equilibrium stages.

Reference to natural occurrence has been made for comparison.

78. Solubilities of some Oxides and Ions in dilute aqueous solutions as calculated on thermodynamic basis and significance in ore deposits.

AMITAVA DUTT, Giridih.

Solubilities of some ions and oxides in dilute aqueous solutions at different values of pH and oxidation potentials have been calculated on the following basis : their equilibrium constants K of reactions with water were determined first from

$$\frac{\text{Sum of chemical potentials}}{\text{Temperature} \times \text{Gas constant}} = -\log K.$$

K was then substituted in log of concentration of solute (solubility) = $-\log K - \text{pH}$ concentration.

Their solubility products were determined similarly. Graphs of solubilities at various pH at 25°C are drawn. Some of the important observations are :

(1) Solubilities of ions and silica decrease with higher pH and become zero when precipitation begins. Oxides become soluble at certain pH and increase with it. Thus precipitation from ions may be redissolved as oxides as in Fe_2O_3 and Al_2O_3.

(2) But CaO and MgO at low pH are dissolved as ions, at medium as oxides and at higher pH as ions with decreasing solubility.

(3) Precipitations of the following start at

$Si^{4}+$: 7·22; Fe^{2} : 6·68; $Ca^{2}+$: 11·75; $Mg^{2}+$: 19·50; K+ : 22·80; Na+ : 25·80; $Al^{3}+$: 3·00 (pH).

and dissolution from

SiO_2 : 7·55 : Al_2O_3 : 6·95; Fe_2O_3 : 7·20; CaO : 6·75; MgO : 6·60 (pH).
MgO : 6·60 (pH).

The solubility data help to explain conditions of deposition and leaching of sedimentary ores. Banded iron deposit has been discussed.

79. On the occurrence of Quartz Veins of Hubli and Yemmihatti.

N. W. GOKHALE, Dharwar.

Two Quartz Veins are located, one at Budar Shingi Village (15° 17′ N Lat. 75° 9′ 45″ E Long) which is 4 miles South of Hubli and the other on a hillock which is 6 furlongs to the West of Yemmihatti village (17° 30′ N Lat, 74° 59′ 45″ E Long). Both the veins constitute elongated hills and stand out in bold relief owing to differential erosion, since the country rock through which these veins traverse, are shales. Total tonnage available from the Hubli and Yemmihatti occurrences is 16600000 and 74200000 long tons respectively. The veins contain small quantity of iron-oxide by way of impurity. The vein material could be used profitably towards the production of inferior quality glass.

(vi) Palaeontology

80. The age of Acanthoceras and Romaniceras in the Cretaceous of South India.

S. S. SARKAR, Calcutta.

Acanthoceras, Neumayr, 1875—In course of his revision of the Ammonites of the South Indian Cretaceous in the Geological Survey of India, the author has found out that, the group of *Acanthoceras rhotomagensis* Defrance, which is known to represent the Middle Uttatur Stage (Cenomanian) of the Trichinopoly Cretaceous, also existed in the Trichinopoly Stage (Turonian) and survived up to the Lower Ariyalur (Senonian).

Romaniceras Spath 1923—The beautiful genus Romaniceras has been reported and figured in India since 1864. In India both the types of Romaniceras occur, that is one with nine ranges of tubercles (*R. medlicottianus* Stoliczka) and the other with eleven ranges of tubercles (*R. ornatissimus* Stoliczka).

The reported age of Romaniceras is Turonian. In India it occurs in Cenomanian and Turonian, while in Japan it has been reported from Senonian (Lower and Upper) e.g. *R. Yubarense* Yabe. According to the author, the figures produced in the French and the Russian texts of this genus, show some differences of characters, when compared to the figure of the genotype (*R. deverianus* d'Orb.).

The Indian species *Ornatissimus* has got a broad or almost flat venter and the apertural breadth is one and a half times broader than the height. It does not resemble other reported Romaniceras from India. Probably it resembles the variety *intermis* (not figured) of *R. deveroides* de Grossouvre 1889 *sp.* which has been reported to be flat formed, from France and this species has eleven ranges of tubercles.

81. On the reported occurrence of Crioceras in India.

S. S. SARKAR, Calcutta.

The fossil *Crioceras* has been recorded by Waagen and Rajnath from the Ukra bed of Cutch, India. During the course of revision of the *Crioceratites* from the

Lower Cretaceous of France, the author observed the absence of the genus in India. Later he re-examined the type specimens of *Crioceras australe* Moore, described by Waagen and confirmed the determination of Spath : *Tropaeum aff. ausrtalis* (Moore) for the same specimen. The author could not examine the *Crioceras* collected by Rajnath. The present report on the occurrence of *Crioceras* in India, therefore, cannot be confirmed.

82. On the Occurrence of Dicroidium (Thinnfeldia) feistmanteli in the East Coast Upper Gondwanas of Vemavaram, Andhra Pradesh.

C. NAGESWARA RAO, Calcutta.

A specimen of *Dicroidium (Thinnfeldia) feistmanteli* is described from the Vemavaram outcrop of the East Coast Upper Gondwanas of Andhra Pradesh. This fossil has been recorded from the Triassic and Jurassic strata of the Gondwanas outside India. The occurrence of this form in the Vemavaram beds suggests that these may not be younger than Jurassic.

83. Ginko (Gingkoites) digitata Brong. from Rajmahal hills, Bihar (India).

R. N. SHRIVASTAVA and S. C. SHAH, Calcuttta.

Two species viz. *Ginkgoites lobata* and *G. crassipes* are known from Jabalpur and Kota beds of Gondwana system in India. Some leaf impressions of the same group are also reported recently from Rajmahal hills, Bihar. Now, a nearly perfect specimen from the collection from Rajmahal hills (collectors : M/s. R. N. Shrivastava and S. K. Ramaswamy in the field-season 1953-1954) has been assigned to *Ginkgoites digitata* Brong. This will be the first record of this species from India.

84. On the reported Acanthoceras from the Umia Series of the Ukre beds of Cutch.

S. S. SARKAR, Calcutta.

An ammonite from the collection of fossils made by Stoliczka from the Ukra Hill in Cutch, above the plant beds of the Umia group, had been provisionally identified by Waagen as *Acanthoceras rhotomagense*. Later Waagen had revised the identification of this ammonite to *Cheloniceras martini* d'Orbigny *sp.* Spath modified the identification of Waagen as *Cheloniceras sp. juv. aff. martini* d'Orbigny.

The author has examined the ammonite specimen. The specimen is so much mutilated, corroded and badly preserved that it is not possible to make a correct determination. It has a general resemblance with *Cheloniceras* Hyatt, but the typical coronate whorl section could not be seen as the aperture is broken and incomplete. On the venter the ribs run straight and no bifurcation of the ribs from the external range nor the characteristic tuberculation of the genus could be traced.

Considering the defective condition of the specimen, the specific determination of the Umia ammonite by Waagen and the discussion of its geological horizon or distribution based on the species *C. martini* d' Orbigny appear questionable.

Probably a *Cheloniceras* of the group of *martini* d'Orbigny occurs in the Ukra Hill Cretaceous beds but it is not an *Acanthoceras* as stated in the text-book on the Geology of India. These Cretaceous beds require further investigations.

(vii) Ground Water

85. Rational development of India's groundwater resources.

G. C. CHATERJI, Calcutta.

The growing industrial and agricultural development in India calls for a rational development of India's water resources. India's groundwater resources are great. Nearly one third of the total land area of the country (811 million acres) is underlain by soft unconsolidated sediments, which comprise the best reservoirs for the storage and movement of groundwater. Under the All-India Groundwater Exploration Project, the Geological Survey of India in collaboration with the Ministry of Food and Agriculture, is engaged since 1954 in exploratoiy drilling and collection of valuable scientific information in order to assess the groundwater potentialities of selected areas in India. The project includes drilling and testing of about 300 boreholes down to a maximum depth of 1500 ft. Uptil now extremely valuable subsurface geohydrological information has been obtained from the boreholes drilled in the States of Bombay, Madhya Pradesh, Madras, Punjab, Rajasthan, Uttar Pradesh and Bihar. In connection with the development of groundwater resources, measures should also be taken for a careful and planned exploitation of the same as irrational localised over-development of groundwater has led to catastrophic results in other parts of the world.

86. Salient features of the ground-water hydrology of Meerut District, Uttar Pradesh.

R. N. MATHUR, Varanasi.

The district of Meerut (28° 35′ N. to 29° 15′ N. and 77° 10′ E. to 78° 5′ E.) is a doab district covering 2,300 square miles to the west Upper Ganga Plain.

The minor variations in the form of the water table over the District reflect the influence of surface relief. The water table stage fluctuates mainly as a result of the alternation of wet and dry seasons. The annual ground-water recharge by rainfall during a normal and a heavy rainfall year comes to 4·4 inches and 15·7 inches respectively. The figures (in inches) for potential and actual evapo-transpiration, soil moisture storage, and surface runoff during a normal rainfall year are 83 0, 23 7, 4·0, and 0·0 respectively.

The Daha area is the only one where the water table stage is being significantly affected by pumping under the comparatively higher pumping rates. In this area the pumping influences have largely been superposed upon the usual seasonal water table fluctuations, and the water table has assumed a new equilibrium position.

As regards the hydrologic properties of water bearing materials the values for porosity, specific yield, permeability, and rate of ground-water movement are 40 per cent, 25 46 per cent, 545·12 gallons per day, and 50·37 feet per year.

The water table stage has not so far exhibited signs of a permanent decline and therefore the pumping rates, even in the Daha area, are within safe limits.

87. Ground Water hydraulics as a geophysical aid with special reference to the Neyvelli Lignite Field, South Arcot District, Madras State.

V. SUBRAMANYAM, Calcutta.

To determine the feasibility of controlling the presence of confined ground water below the lignite deposit, which occurs between depths of 170 to 250 feet below ground level, a large scale pumping test was conducted in the Neyveli Lignite field during February—June 1956 with twenty pump wells and thirty observation wells, tapping aquifers between the depths of 240 to 360 feet below ground level, in the area proposed for immediate mining and where mining operations are now under way. Several aquifer performance tests were also conducted in wells tapping individual aquifers during the last four years to determine the aquifer coefficients and the permeability of the materials constituting each aquifer underlying the lignite deposit.

During the tests equilibrium or near equilibrium conditions were reached within twenty four hours. Careful analyses and interpretation of all the test data by the method of images, shows that the primary cause for equilibrium conditions to be reached within short periods of pumping, is due to leakage from one aquifer into another, through breaks in the aquicludes separating them. Methods used in determining the leaks or zones of leak, which act as spot sources of recharge, how these findings have been substantiated by known subsurface data of the area and how these hydraulic tests prove to be geophysical and have been brought out in details in the paper.

88. A note on the Ground-water Survey in the area around Jhargram, Dt. Midnapur, W. Bengal.

R. K. DUTTA and T. C. BAGCHI, Kharagpur.

The area around Jhargram (Lat. 22° 27′ 20″ No; Long. 87° 0′ E.) forms a plain with gently undulating surface with local topographic depressions and elevations. Rock formations of the area include laterite and lateric clay with lenses of sand and clay of Quarternary Age and newer alluvium along the Cossai river. In the present area groundwater occurs in coarse to fine sands below laterite and lithomargic clay. The depth of water table in general, varies from 65′ ft. (in the south) to 20′ ft. or even less (in the north) below land surface. The maximum depth of 64′ ft. was encountered at the well of the Basic Training College and the Government College Shallow dug wells 3′-5′ ft. diameter, 30′-70′ ft. deep and lined with concrete rings, are the source of existing water supply The water table elevation declines from south-west to north and north-east and is roughly subparallel to the slope of the country. Available data on tube well suggest that water level in them are same as that in the shallow dug wells but at a depth of 75′ ft. the supply is, perhaps, prolific, yield being about 300 G P.M. Sample of water examined is found to be potable and is considered suitable for irrigation.

Judging from the nature of the groundwater table in the area and effluent seepages it is suggested that wells dug along the Bachhurdoba depression, and along the alluvial bank of Norakhal may yield perennial supply of potable water.

89. Near surface ground-water conditions around Powerkhedi Agricultural Farm, Hoshangabad District, Madhya Pradesh.

SANATKUMAR BASU, Calcutta.

An area of about 140 square miles around Powerkheda (22° 42′ : 77° 45′; 55 F/10), Hoshangabad district, Madhya Pradesh, was surveyed. The area is included by latitudes 22° 35′ and 22° 45′ and longitudes 78° 36′ and 78° 49′. A little over 100 dug wells were examined and water samples from about 60 wells were chemically analysed.

The area forms part of the Narmada Valley which is bordered by the Satpura range on the south and the Vindhyans on the north. The general slope of the area, on both sides of the Narmada, is towards the river.

Geologically it can be classified as a soft rock area. Clay and sands are the main constituents. Sands are fine to very coarse and at times gravels are intermixed with them. Sands are mostly quartzitic. They are also derived from Trap rocks, Bagra conglomerates and Vindhyan sandstones. The grains are generally subangular to rounded. The soft rocks overlie the laterites underlain by traps in the area surveyed. The thickness of the soft rock is about 70 feet as determined by a tubewell drilled at Powerkheda.

Groundwater in the zones tapped by the dug wells in the area surveyed occurs under water-table conditions. Depths to water in the area varied between 4 and 63 feet below land surface. The movement of ground water is towards the Narmada river, the slope being about 15 feet to a mile.

The water-table shows a steady decline from early October to mid-June. The rate of fall per day was constant, but varied between ·01 and ·15 foot in 24 hours. After mid-June, the water level reverses its trend and begins to rise or recover. The rate of rise is very fast due to monsoon rains, reaching a maximum of 2·6 feet in 24 hours in some cases. The difference between monsoon and summar water-level was measured to be about 18 feet.

The quality of water is generally quite good, excepting a few local zones. The chloride ranges between 8 and 100 ppm., carbonates from a trace to 12 ppm., bicarbonates from 173 to 675 ppm., sulphate from 10 to 82 ppm., and pH from 7 3 to 8·4.

B. GEOGRAPHY

(i) Geomorphology

90. On the occurrence of Cup-marked boulder at Dhudhuya, Mayurbhanj District, Orissa.

B. C. ACHARYA and S. ACHARYA, cuttack.

The authors visited a village named Dhudhuya, where a cup-marked boulder rests on a rocky and flat surface on the top of a mound. These cup-marks are about 15 in number and occur on all faces of the boulder. The singular presence of it on the top is conspicuous, as no other boulder or rock surface show depressions of this type. The position is anomalous and attempts have been made to decipher the origin of these cup-marks.

91. The Origin of the Rajasthan Desert.

ENAYAT AHMAD, Ranchi.

The origin of the Rajasthan Desert is consequent upon its low relief, continental location in respect of the weaker moist maritime winds, the effects of the plateaus on the north-west and west, the existence of a strong westerly upper-atmosphere air current. Sand is derived from the disintegration and desquamation of the surface rock.

The view that the major portion of the sand is of drift origin blown from the Rann of Cutch and the Sea Coast is not appealing. Topographical sheets show that the sand dunes are confined to the east of the Nara. The amount of sand is so much that its major proportion would need the Rann of Cutch initially to be higher landsurface or else a continuously rising landsurface. None of these conditions is known to have existed. Moreover, nowhere else in the world has coastal sand led to the formation of a desert.

As to the archaeological evidences of Beluchistan and of the Sutlej Valley settlements, they cannot be said to be indicative of a long continued moist period but only a minor climatic phase within a longer arid period.

It is an inland drainage area. There are bare, bold and rounded rocky outcrops with wind-heaped sand in series of ridges, dunes and hillocks

92. Under ground Water level in the Bist Jullundur Doab, Punjab (India).

O. P. BHARADWAJ, Ludhiana.

Some factors affecting the movement of the underground water-table in the Bist Jullundur Doab region have been discussed. This discussion is followed by a statistical analysis of rainfall of the region from the year 1891-1930. The standard deviation for the same period has been calculated and the 'significance' of change in ten yearly averages has been ascertained. This analysis has clearly shown a 'significance' increase in rainfall and the consequent rise in underground water-table has been explained.

The rise and the fall of water-table in a number of wells in the region for different seasons for a number of years has been observed and the relation of this rise and fall to the seasonal variations of rainfall has been shown.

Some remedial measures to check the alarming rise in water-table have been suggested.

93. Evolution of the Physiognomy of the Duns.

RAMESH DUTTA DIKSHIT, Allahabad.

The Duns are a set of longitudinal tectonic valleys set between the slaty and schistose ranges of the Lower Himalayas to the north and boulder clay and massive tertiary sand-rock-built Siwalik hills to the south. They are most characteristically developed only to the west of Naini Tal. In this paper an attempt has been made to explain the evolution of the physiognomy of the Duns and to determine the age of their evolution, by tracing the origin of the Siwaliks, the flanking rances to the south, to which, it is thought, the Duns largely owe their characteristic features. Had these ranges not been there, the Duns would have formed a part of the contiguous plains to the south. Different theories regarding the past history of the area have been reviewed. The causes for the marked diffrence between the levels of the Duns and the plains are explained. General composition of the surface and underlying rock-strata is briefly dealt with and their effects on water table explained. Besides, an attempt is made to explain the relation between the Bhabar, the Terai and the Duns, all of which are the phenomena of the immediate foot-hills of the Himalayas.

94. Landslides in the Lish Valley, Darjeeling district, with special reference to flood control problems of North Bengal.

M. S. JAIN, Calcutta.

The catchment area of the Lish river up to its emergence on to the plains near *Chunabhati* (26° 54′ : 88° 35′) is approximately 16·5 sq. miles. Geological reconnaissance revealed that the entire catchment area is built up of four different groups of rocks. The number of landslips in the Lish catchment, till the time of author's study, was 130. The table given below shows the distribution of the slips formation-wise and also the area of the various rock units.

	Rock types	*Area*	*No. of slips*
1.	Darjeeling Gneiss	1·5 sq. miles	2
2.	Daling Series	8·0 „ „	115
3.	Gondwanas (coal-bearing Damudas) ...	1·0 „ „	6
4.	Siwaliks (Nahans)	6·0 „ „	7
	Total	16·5 sq. miles	130 in all.

The above statistical analysis is rather significant in that it is seen that 90 per cent of the slips are confined to the Daling Series of rocks though these only occupy about 50 per cent of the total catchment area. All the slips in the Daling formations were comparatively larger and had brought down a much larger volume of rock debris than those found in other formations. This is due to the fact that weak phyllitic and other fissible schistose rocks are less competent and thus structurally more prone to sliding than other groups of rocks in the catchment area.

Conditions in the adjoining streams such as Gish, Neora and Chel river etc., are remarkably identical. Unless scientific and less expensive methods of landslide control and of soil conservation are evolved no temporary palliatives such as check dams or treatment of any individual massive slide scar such as *Pabringtar* (26° 57′ 30″ : 88° 31′ 30″) or *Yaungmakum* (26° 56′ : 88° 31′), would be helpful in fighting the menace of floods in this unstable region which is bordering the entire northern frontier of West Bengal, because the problems involved are regional and only long term measures could help. It is suggested that regional ground water studies and soil mechanics data on the stability behaviour of the locally available soil and rock material be ascertained and pilot projects of slide stabilisation and treatment be executed to work out the cost-benefit ratio. Legislative and administrative measures such as banning of *Jhum* practice of cultivation and creation of protective forest belts in affected areas particularly for the 1500 feet above the stream-beds are also essential. The catchment areas should be quinquennially geologically surveyed and precision levelling of certain bench marks be repeated once in five years to detect if any secular movement has occurred so that remedial measures could be devised well in advance.

95. A Geomorphological analysis of landforms in Gwalior State.

SENAPATI JOSHI, Varanasi.

I. THE GEOMORPHOLOGICAL UNITS

Gwalior State extends between 23° 30′ N and 26° 49′ N Lat. and 76° 6′ E and 79° 38′ E Long. and occupies an area of 25,041 sq. miles. It forms a triangle based on Vindhyan Hills, and is bounded on the north and north-west by river Chambal, on west by western Parbati and on the east by river Sind and river Betwa.

The greater part of the area is covered with Vindhyan formations. The southern part is covered with Deccan trap, south of which, in the Narbada Valley, the Bagh and Lameta beds are also exposed, along with the lower series of Vindhyans which form a scarp overloking the Narbada Valley. In the north, beds of Gwalior series are well exposed and a part of Bundelkhand gneiss covers a little portion of the area on the east. The following geomorphological units have been distinguished :—

1. The Gangetic alluvial plain.
2. The Vindhyan ranges.
3. The Malwa plateau.
4. The undulating ridges of Gwalior series.

5. The Bundelkhand massive.
6. The Narbada Valley.

II. EVOLUTION OF LANDFORMS

The evolution of landforms in the different geomorphological units of Gwalior state has been studied in the light of the Division concept.

The northern Gangetic alluvial plain has been cut into a ravinous bad land by the forces of erosion. The Vindhyan plateau has been reduced to elongated escarpments owing to the low dip of the strata. The Deccan trap in the Malwa plateau has given rise to flat-topped topography. The Bundelkhand granites have a rolling landscape. The Narbada valley has a ravinous, topography while to its north Vindhyan, and Lameta and Bagh beds have produced a scarp overlooking the valley.

96. Occurrences of floods in the Mahanadi Delta.

BIJOYANANDA MISRA, Patna.

Floods are frequent in the Mahanadi delta and innundate large tracts of lands. During the period of 89 years (1868-1956) the delta experienced 21 years of high flood and 49 years of medium flood.

The main causes of flood are—(a) High discharge of the Mahanadi during rains, (b) the abnormally low gradient of the rivers, (c) the unscientific construction of the Naraj weir which has blocked the mouth of the Kuakhai river by deposition and forces the Kathjuri river to carry more water than its capacity, during the rains, and (d) lack of suitable flood embankments.

The Daya-Devi doab, the Mahanadi-Nuna doab, and the Brahmani-Birupa doab are frequently flooded. Average annual loss by floods is about 12 lakhs. Moreover, seven thanas of the Cuttack district and three thanas of the Puri district which are frequently flooded show signs of depopulation. Floods of medium type, however, are beneficial, for they give at places a fresh deposit of silt to the riverside fields which grow excellent crops of gram, oilseed and paddy, and flush the malarious stangnant pools in the waterlogged littoral tracts of the delta.

Peak flood lasts for not more than two days and it takes about two days to reach the delta from Sambalpur. The Hirakud reservoir can store the excess flood water for six days during the peak discharge. Under control, river level will never rise above 90 feet near Naraj which is the minimum level for high flood. The construction of the new Naraj weir, the Kazipatna weir to regulate the discharge of the Kuakhai, and many flood embankments will further minimise the danger of floods.

97. Geomorphology of the area around Simultala, Bihar.

DIPANKAR NIYOGI, Kharagpur.

Landforms around Simultala (86° 32′ 30″ E; 24° 42′ 30″ N) are fully structure-controlled. Hill ranges are all homoclinal hogback ridges with homoclinal valleys in between. In hill-and-valley areas the drainage is of the trellised type, while a dendritic pattern prevails in the rest of the area. The plunging syncline in the east has a very clear topographic expression in convergence of strike ridges. Similarly, faults can be deduced from the topographic map from off-setting of strike ridges.

Evidences indicating the presence of remnants of two ancient erosion surfaces are present in the area. The upper i.e., the older one is an old peneplain, indicated by the corcordance of hill summits around 950′ above mean sea level, as well as by the presence of thick soil on two hills which rise above this level and are monadnocks with reference to this peneplain. The lower erosion surface is on the softer rocks of the area. It is an undulating surface, at 825′ around Simultala, rising to the south so as to unite with the upper surface and falling to 725′ in the north, where there is thick red alluvium.

98. A Geomorphic note on Kishangarh and surrounding areas, Rajasthan.

DIPANKAR NIYOGI, Kharagpur.

Geomorphic study of the area around Kishangarh reveals interesting correlation with lithology and structure. Doubly-plunging, short dome-and-basin structures in Aravalli rocks have given rise to abruptly terminating ridges, while the more gentle plunge of the Delhi rocks is apparent in the long homoclinal ridges and valleys. Mandaoria hill and the adjacent valley, both made up of Aravalli rocks, are, respectively, a synclinal hill and an anticlinal valley.

Hills show the nickpoint or the break in slope, typical of arid regions near the base. The gravity slopes, above the nickpoint, range between 25° & 35°, while the wash slopes are from 9° down. The rocky pediments are about 400 yards wide and merge through bajada plains into the practically flat alluvial plains. In between the Tonkra ridge and the Khatoli ridge is an enclosed valley with internal drainage. As some integration of drainage and draining of the enclosed valley has just started by cutting across the ridges, the geomorphic cycle in this arid mountainous region may be said to have reached early maturity.

Remnants of two ancient erosion surfaces, one around 2,000 feet (above M.S.L.) and the other around 1,400-1,500 feet are present. The latter surface has been recently uplifted by at least 100 feet and rivers are actively engaged in cutting the same.

99. Some aspects of the Geomorphology of the Machkund Catchment.

AMAL KUMAR SEN, Calcutta.

The paper studies the important geomorphic features in the northern Machkund Catchment. The drainage pattern of the area is complex and the valleys of the Machkund and the Kinchor are superimposed. Several 'nickpoints' can be identified. The Duduma and Gurdai waterealls are considered as not due to lithological differences. Certain 'breaks' are explained as due to 'static' rejuvenation.

Monadnocks are then studied with their accordance of summits. The author traced three peneplain surfaces and illustrated his findings with superimposed and longitudinal prifiles, etc.

100. An average slope map of the Damodar Basin.

ADYA SHARAN, Patna.

In the present map, an attempt has been made to show the average slope of the Damodar basin. Slopes have been determined from the relevant One Inch to a Mile sheets of Survey of India, with the help of a gradient scale constructed for the purpose. Then the results have been transferred on a small scale map of tthe Damodar basin. This map shows the following six categories of slopes.

Slope	Gradient
0° to 1°	Flat to 1 in 60
1° to 2°	1 in 60 to 1 in 30
2° to 3°	1 in 30 to 1 in 20
3° to 5°	1 in 20 to 1 in 10
5° to 14°	1 in 10 to 1 in 4
14° and over	1 in 4 and steeper.

The resulting map gives a good visual impression of the slopes in the Damodar basin. It provides a good basis for the study of surface run-off, flood, erosion, vegetation, agriculture, landuse, settlement and other geographical distributions in the basin.

101. The drainage pattern of Chota Nagpur.

RAM PRABESH SINGH, Ranchi.

The general drainage pattern of Chota Nagpur is radial in character, the two most important foci of initiation being the Ranchi and Hazaribagh highlands. An outstanding exception is provided by the Damodar which flows in an easterly direction in a structural basin -and is therefore essentially structure-guided. The western section of the plateau provides a separate drainage axis guided in the main by Deccan lava flow and later uplifts. The drainage in the Rajmahal is essentially dependent for its characteristics on the presence of the hinge-zone trending roughly N.S. The Subarnarekha, South Koel, and the Mor rivers provide clear examples of superimposition.

Wherever there has been an uplift it has been followed by piracy through abstraction of head streams. Best examples are provided by the eastern Ranchi plateau. Examples of river capture by headward erosion can be seen in the Garra, the Gurma and other tributary streams of the Subarnarekha in Dhalbhum.

The development of the following regional or local drainage patterns may be recognized :—

1. Radial pattern on a small scale, e g. in Parasnath Hill, Panchet Hill, Dalma, etc.

2. Dendritic pattern, e g. in the massive igneous rocks and complex metamorphosed rocks, the horizontal sedimentaries of the Damodar basin and the Rohtas plateau.

3. Trellised pattern on the ancient folded mountains of Dhalbhum.

4. Fault trellised pattern in parts of the Damodar valley where a series of parallel faults have resulted in alternative bands of strong and weak rocks.

5. Barbed pattern in the Sankh valley.

6. Rectangular pattern reflecting the influence of joints, such as in North Palamau and south Shahabad, etc.

7. Parallel pattern in Dalma range, as also on the northern and eastern rims of the Ranchi and Hazaribagh plateaus.

8. Annular pattern in the Sonapet dome, as also in parts of the northern section of the Chota Nagpur plateau.

102. Geomorphological Evolution of the Highlands of Rajmahal.

R. P. SINGH, Ranchi.

The highlands of Rajmahal comprise a chain of level lava plateux, sculptured hills interrupted with valleys of varying volumes and undulating denuded surfaces. The shaping of the Rajmahal landscape has been the work of Tertiary times when the Rajmahal hills were sculptured, the valleys carved and plateaux intersected.

Important events that go to make up the Rajmahal landscape from the Archean to the Tertiary are :—

1. Discontinued Gondwana accumulation over the pre-Cambrian surface.
2. Series of Rajmahal lava flows of Jurassic Period which flowed unconformably over the Gondwana sediments.
3. Denudational phase modifying the original form of the Rajmahal traps.
4. Uplifted western and southwestern parts initiate another denudational cycle.
5. Tilting of Rajmahal to the east and north forming a hinge zone between the elevated and tilted country which is a significant fact in the study of Rajmahal morphology.

Drainage had been altered in various chapters of its evolution. Present patterns in relation to the structure have been of great significance in establishing the denudational chronology of Rajmahal.

103. Spheroidal Weathering in Vindhyan Sandstones.

N. K. P. SINHA, Varanasi.

The paper deals with sub-surface rotting and expoliation resulting in the formation of spheroidal cores or "core boulders" in the massive scarp sandstones of the Upper Kaimur Stage of the Vindhyan System in the districts of Mirzapur and Banaras, notably in the road cuttings at Kewaighat (24° 37′ 14″ N, 83° 3′ 5″ E) above Markundi on the Robertsganj-Chopan road; at Chunar (25° 7′ 22″ N, 82° 52′ 47″ E) on the eastern face of the fort crowned hill; and at Latifshah (25° 1′ 13″ N, 83° 14′ 29″ E), about 2 miles S.S.E. of Chakia.

Peeling off of concentric shells in the well-jointed scarp sandstones is the result of a succession of processes. The percolation of alkaline solutions along joints during rainy season produces hydration (esp. ferrugination), oxidation and other chemical changes of the outer surfaces of the jointed blocks and further leads to their expansion and rotting. Later, disappearance of percolation water during dry season produces differential expansion of weaker acid-soaked surfaces and the core, resulting in a clear line of separation between them. This chemical and mechanical action from season to season has proceeded for millions of years since the development of rock joints and has led to sub-surface exfoliation and spheroidal weathering.

At Kewaighat, the spheroidal boulders are present in the steep faces of the road cuttings, 30 to 40 feet beneath the mantle rock and there is every possibility that they exist even at greater depths, as the ground-water level is very low here on the steep-faced scarp. The developmnt of spheroidal cores with particularly thin shells, has taken place in the lower beds of the scarp sandstones which contain finer sand-grains and more argillaceous matter. No evidence of spheroidal weathering has been found in the Dhandraul quartzites which overlie the scarp sandstones.

(ii) Climatology

104. A Preliminary Analysis of Dew Observations at Waltair.

B. PADMANADHAMURTY and V. P. SUBRAHMANYAM, Waltair.

The paper gives a general survey of dew observations made at the Agricultural Meteorological Observatory of the Geo-Physics department at Waltair by means of a Duvdevani Dew Gauge installed at a height of one metre above ground. Simultaneously, a terrestrial radiation thermometer was also placed at the same height. The period of observations was from October 1957 to March 1958. Attempt has been made to investigate the influence of meteorological conditions of the surface layer on the deposition of dew. Screen minimum, mean relative humidity and mean daily wind were obtained from the records of the meteorological observatory at the aerodrome. Simple correlation coefficients were calculated in respect of the amount of dew on the one hand and the vapour pressure, depression of the radiation minimum temperature below the screen minimum, as also the wind speed, on the other. They came out to be +0 34, +0 10, −0·06 respectively, and thus the general assumption is established that while increase in vapour pressure and lowering of radiation minimum favour dew deposition, increase in wind speed has a discouraging effect. Limiting conditions were established for dew deposition in case of vapour pressure and it was found that increase in vapour pressure increases dew deposition, although not proportionately. Dew formation is favoured very frequently when the difference between the radiation and screen minimum temperatures is both positive and negative in the range +2 to −2°F; dew incidence was maximum with the difference between 0 and - 2°F.

The discouraging effect of the dual influence (*viz.* turbulent mixing and evaporation) of wind on the deposition has been observed. The general nature of decrease in dew deposition as season passed by is presumably due to decrease in atmospheric humidity and rise in air temperature.

105. Influence of Sunspot Cycle on the Cyclonic Storm Tracks over the Bay of Bengal during the Northeast Monsoon season.

PRABHAT K. SEN GUPTA, New Delhi.

The tracks of cyclonic storms moving across the Bay of Bengal during the northwest monsoon season for the period 1905-1948 have been found to reveal the following characteristics indicating an influence of the solar cycle :—

- (i) With the approach of sunspot minimum, a westward movement of these storms across the south Bay of Bengal with a tendency to strike the eastern coast of southeast Madras becomes a common feature.
- (ii) During the maximum phases of the sunspot cycle westward tracks are fewer and recurvatures towards the north or northeast become more frequent with the result that fewer storms strike the eastern coast of southeast Madras.
- (iii) More cyclonic storms are seen over the Bay of Bengal during the minimum phases than during the maximum phases of the solar cycle.

These variations are attributed to periodic latitudinal shifts of the upper atmospheric pressure and wind systems in the steering layers in association with the sunspot cycle.

The effect of these variations on the rainfall of southeast Madras is manifested as a 'regular recurrence of more frequent excess rainfall days during sunspot minimum phases with intervening periods of subnormal rainfall'.

106. Continentality Trends over India and the Neighbourhood.

V. P. SUBRAHMANYAM, Waltair.

The purpose of the paper is to emphasize the role of thermal continentalities in the general study of climatology. The parameter chosen for the analytical study is K' defined as the ratio of the actual to the expected summer concentrations of thermal efficiency, a concept that was first recognized by Thornthwaite.

Making use of the values of K' for about 250 stations in and around India, an isocontinental map has been prepared. The most prominent feature of the map is the division of the country into two major zones of entirely different continentality characteristics, the demarcating line being the isopleth of K' = 100 (ratio expressed as a percentage). Comparison of the isocontinental map with other climatic maps shows striking similarities to the moisture indices rather than the thermal indices, and this lends support to the view that the continentality features of a region are determined essentially by its moisture regime.

The study of the altitudinal variation of K' in the two zones reveal highly interesting characteristics at lower and higher elevations in south and north India. Levels of normal continentality, continentality reversal and continentality invariance are identified. Further extension of this work on a quantitative basis may reveal other features of great significance in the physical climatology of India.

(iii) Economic Geography

107. Cattle Raising in Andhra Pradesh.

B. N. CHATURVEDI, Hyderabad.

Andhra Pradesh ranks seventh among the states of India in cattle wealth. There is however the climatic handicap of high temperatures for eight months of the year, rendering the state unsuitable for raising milch cattle. Milch buffalo is more suited to the climatic conditions specially in the coastal districts and forested areas which are more humid. The main cattle breeds in the state are Ongole, Krishna valley, Malvi, Deoni and Hallikav types. Kapilians breed is small in number but held in high esteem. Lambada tribes favour Hanamkonda breeds. Bulls of the Amritmahal breed are the most beautiful. Recently there has been an appreciable decrease in total number, but the useful varieties have actually increased in number. The increased cost of maintenance induces the owner to dispose off useful animals. Out of 180 taluqas in the state only 52 can be classed as having very high, high and high medium densities. 66 taluqas have low density and 21 very low density. Markets and fairs provide easy trade facilities. Suggested measures for improvements are :—(1) Introduction of improved fodder grasses, (2) Temporary fencing of village pastures, bunding the gallies and scattering grass seeds, (3) Improvement in housing conditions and drinking water, (4) Dry fodder to be given after cutting and mixing with water and concentrates feeds in tubs—a practice unknown in many parts of Andhra Pradesh, (5) Co-operative marketing of products, (6) More artificial insemination centres, key village centres, and breeding farms.

Andhra Pradesh can breed and supply working bullocks successfully to meet all the requirements within the state and a portion of the requirements of the neighbouring states. The conditions are equally good for raising breeding bulls from selected indigenous types as well as from imported breeds. As regards breeding of cows, only working and breeding cows can successfully be raised. The climatic conditions are unsuitable for raising milch cattle, but introduction of better breeds from other states may be found economical. Only healthy cows of Ongole and Deoni breeds with good management can compete with buffaloes in this sphere.

108. Water supply for Rourkela Plant and Township.

R. GAUNTIA, Patna.

Rourkela, a small railway station situated on the Brahmani river is the seat of a large steel plant. One of the first problems of the new township and the plant was water supply. The summer flow of the river here is only 20 ounces against the minimum requirements of the plant of 125 ounces. A dam has, therefore, been constructed across the Sankh, a tributary of the Brahmani, 16 miles upstream of Rourkela near Mandira village (21° 10′ N and 84° 40′ E), ten miles from Rajgangpur, Orissa's cement town. The Sankh rising in Chota Nagpur, has a catchment area of 2366 sq. miles with a mean annual rainfall of 57·97 inches, which ensures regular flow. The Mandira dam is an earthen barrier across the river, 1365 ft. long and 90 ft. high with a reservoir capacity of 0·27 million acre ft., which is sufficient not only for Rourkela but can cater to the industrial belt that will eventually spring up. Besides, it can provide irrigation in the Sankh valley and also lower down up to the Brahmani delta. It can also generate hydel power and moderate floods. The structure and physiography are favourable. The river here flows through a forge between two hills of carbonaceous phyllite and schist by damming which a large lake has been formed Some 17 small villages have been submerged, but the benefit that may accrue are likely to be much greater than the loss sustained.

109. A note on industries in Akola District, Berar.

N. G. JAIN, Amravati.

The agricultural district of Akola is also well developed industrially. More than 8 per cent of the population of the district is engaged in industries. Cotton textile, manufacturing of oil, vanaspati ghee, and soap and other industries based on the agricultural raw-materials are developed, but there has been little development of cottage industries. A few industries are discussed in the paper.

It is suggested that suitable industries should be developed in small units, which in turn may feed the big concerns. For example, small units of cotton spinning establishments in the rural area, can very well supply yarn to cloth manufacturing centres located in the urban areas.

110. A Geographical Analysis of Rural Markets of the Deoria District.

SURYA NARAIN PANDEY, Varanasi.

The Deoria District occupies the easternmost part of U.P. and has an area of 2,093 square miles and a population of over 21 lakhs. It is divided into five physical units--Bhat, Bangar, Tarai, Khadar and Kachhar. The District is served at present by 327 miles of metalled and 82 miles of unmetalled roads, and about one-third of its area is inaccessible. Three main clusters of population may be distinguished : (i) South of Deoria town, (ii) around Kushinagar and (iii) between Fazilnagar and Tamkohi. The Tarai is sparsely populated. Elsewhere the distribution of population is uniform. The distribution of markets is to a considerable extent related to the distributional pattern of population.

The number of markets has increased from 272 in 1908 to 387 in 1956. The markets have formed three concentrations—(i) east of Kushinagar, (ii) east of Bhatni and (iii) south-western part of the district. The first two concentrations coincide with the two population clusters, but the location of the third is related to the land use pattern. The Tarai area has few markets. Elsewhere markets are uniformly distributed each forming a circle with a radius of less than 2-miles. Three types of marketing areas may be distinguished: (i) decadent, (ii) stationary, (iii) active. Most of the markets show a gradual decay owing to declining agriculture. To-day only ten markets—including Tarkulwa, Dudahi and Bhatni which are whole-sale, are actively serving the district.

111. Characteristic features of the Rice Culture in Kashmir.

A. N. RAINA, Jammu.

The paper deals with the problems of rice cultivation in the vale of Kashmir. Rice is the staple food of a large section of population in the valley and covers more than 3½ lakh acres The success of this crop depends to a remarkable degree upon the irrigation from canals, streams and ravines. The effect of topography is seen in the stair-case system of fields through which irrigation has been possible because of gradient and gravity.

The transplantation method of sowing is preferred to broadcast, as it gives surer results. Soon after the Rabi crop a good deal of ploughing prepares the soil-bed when snow and ice is allowed to cover the plots. The thawing pulverises soil and the fields are prepared with farm-yard-manure.

The indigenous process of putting seeds in pots with regulated temperature and moisture in closed rooms is still helpful. The sprouted seeds are ready for sowing in April-May at the rate of 48 lbs. on an area of 60′×30′. By the end of June the seedlings are ready for transplantation. These are transplanted at the age in weeks equivalent to the number of months which the crop takes to mature. The China paddy is preferred for its high yield and ease of cultivation. It is not easily affected by droughts because of its long roots. The two pronged operation in which weeding is combined with the loosening of the soil round about the plant is in reality the most important operation. Hybridization of the Russian 3073 and U.S.A. 729 type appears promising.

112. The food problem of India.

MOHD. YUNUS, Naini Tal.

Inspite of the Grow More Food Campaign, Self-sufficiency Drive and the Five Year Plans, food shortage continues to be a nightmare. During the last 11 years food grains of the value of about Rs. 1,500 crores have been imported. This has caused a great drain on our Sterling balances; and has been, to a large extent, responsible for our foreign exchange crises.

In this paper an attempt has been made to analyse the food problem in relation to the increase of population and the low agricultural production.

India with three-fourths of her population engaged in agriculture, is to become self-sufficient in food supply. Remedies suggested include the following :—

1. Check on the growth of population,
2. Increase in food acreage and yields,
3. Decrease in quantity of cereals in the diet,

4. Improvement in the breed of cattle to improve their milking capacity,
5. Mechanization of agriculture in larger farms,
6. Increase in acreage under vegetables and fruits,
7. Land improvements, and
8. National crop planning and land-use survey.

(iv) Human Geography

113. Settlement Type and Pattern in Bijnor District, U.P.

SHIVATOSH DAS, Varanasi.

The Bijnor lies in the north-west corner of Uttar Pradesh. Physically the area can be divided into : (a) the Siwalik region in the north, (b) the Sub-Himalayan region in the N.E., and (c) the Ganga Plain Region. The district is not well drained. A series of small swamps and marshes are found along the old beds of the Ganga, Khoh and Ramganga rivers. The average rainfall is 40 inches.

The population is unevenly distributed throughout the area, being influenced by physical and cultural factors of the area. Rivers have played the greatest role in the selection of sites for human habitations. In the distribution of settlement pattern three distinct characteristic types have been distinguished : Compact, semi-compact and dispersed. Compact settlements are the most prevailing type covering about 77% of the district, and occur in the Trans-Khoh tract, and the central and eastern half of the western uplands. Semi-compact settlement covers the rest of the western uplands, Ganga Khadar and major part of the Sub-Himalayan region. The area under this type of settlement is about 16% of the whole district. Dispersed settlements are found in a very limited area in the Siwaliks, covering about 7% of the area of the district.

Most of the villages are rectangular and square in layout. In the Siwaliks, however, amorphous pattern is seen.

114. Ghirths of Kangra Valley—A Study in Agricultural Society.

S. L. KAYASTHA, Varanasi.

Ghirths predominate in the Kangra Valley and are also scattered in the adjoining parts, generally possessing the richest and most open lands. Various customs, religious practices and physiognomic characters point to the fact that the Ghirths belong to the indigenous stock. With their labours they have fashioned the agricultural landscape of the Kangra Valley, and the natural habitat has similarly moulded the pattern of their life and activities. They thus furnish good example of human adjustment to natural environment. Ghirth economy is becoming more diversified as some of them are compelled to take to other occupations on account of paucity of land. Fragmentation of holdings has shattered the economic basis of agricultural economy. Agricultural density is as high as 1251 per square mile and standard of living is low. Further improvements lie in increasing yields and by supplementing income from other sources. By and large, an average Ghirth peasant is a poor, illiterate person living on the subsistence level. He is superstitious and conservative. Many forms of aboriginal faith still a potent influence, but old ideas and practices are being discarded by the younger generation.

115. A Geographical study of Sculpturing in Magadha with special reference to the Patharkatti area.

S. A. MAJID, Patna.

The paper is an attempt to study the main geographical aspects of sculpturing in Magadha both in the past and present times. It begins with a general discussion of the physical and cultural landscape of Magadha. A brief history of sculpturing in the area is then traced. This is followed by a somewhat detailed consideration of the general characteristics and distribution of sculptures. Then comes the question of the varieties and occurrence of rocks of which the sculptures are made. The paper concludes with observations regarding the location and salient features of the stone-carving industry in the Patharkatti area about 24 miles north of Gaya, where the industry has been localised since very early times, largely due to the availability of suitable rocks and traditionally skilled labour, but is now in a state of decline and neglect, due mainly to paucity of market.

116. Dibdi—a Study in the Rural Geography of Ranchi Plateau.

RABINDRA NATH RAY, Cuttack.

The village Dibdi, 4 miles south-west from Ranchi town, inhabited by both Oraons and Christian converts, is situated at an elevated plateau of 2050' level and has infertile soil and deep subsoil water. Large scale deforestation has deteriorated the climate. Agricultural lands are terraced and are classified into 3 categories (1) Garha, (2) Tanr, (3) Chaura lands in relation to water Most of the lands are single-cropped and agriculture is primitive. Irrigation water is supplied by deep wells and vegetable gardens are nourished by well-water. The village lacks any definite plan, but is made up with different patches of homesteads known as "Kochas". There are seven such "Kochas". Most of the houses use mud, bamboos, sal-logs and titles as building materials. Improvement community centres are the Church as well as the "Akhara". The village has a deficit economy and most of the villagers are unskilled or semiskilled labourers working in the town.

117. Settlement pattern of North Bankura, West Bengal.

AMAL KUMAR SEN GUPTA and SUPRAVA CHAKRABARTI, Calcutta.

The entire area was traversed for reconnaissance survey and two maps to show different forms of settlements and their regional pattern have been prepared. The pressure of population on the limited arable lands, social customs and traditions of the inhabitants, entrance of diseases from the adjoining districts are traced, besides the geographic environment, to explain the various forms and patterns of settlement within the area. Five settlement regions which may be distinguished are River side agricultural compact, River side agricultural scattered, Forest and Forest side scattered Agricultural cum lumbering; Road side linear, Highland compact cum scattered.

The analysis of the various forms of settlements shows some social and economic implications on the distribution of various forms of settlements that are significant for balance regional planning.

(v) Population Geography

118. Rural population of Chota Nagpur.

HEM PRIYA DEVI, Ranchi.

The population of Chota Nagpur has an agrarian base. About 90% of the population lives in 27,708 villages. All the districts of Chota Nagpur Division except Singhbhum have a higher percentage than that of India as a whole where about 82% people live in villages. The industrial and mining districts of Singhbhum and Dhanbad have 12·5 and 3 5 per cent less than Bihar's rural population (93%).

An analysis of the rural population of Chota Nagpur shows that there are three district elements—the "primary", the "secondary" and "adventitious groups", but the last group, though not in great number, forms a class by itself being composed of retired people and those who work in nearby towns and mines.

The distribution of rural primary population depends upon the activities carried out in the areas. The people of the thanas, having mining, industrial and urban centres, are engaged in multifarious activities whereas the people of thanas denied with such assets have to depend upon chiefly agriculture.

The land has remained almost constant in all the thanas, but the population has been constantly increasing. A comparison between the land and people of each thana gives an idea of the pressure of population over the land. It is only in the plain, industrial, mining and urban areas that pressure of population upon land is great, but a greater part of Palamau, Ranchi, Hazaribagh and South Chota Nagpur has plenty of land awaiting utilisation. Thanas, having extensive cultivable lands, meet the demand of food of the urban population.

119. The Regionalism of Birth and Death Rates in India.

GURDEV SINGH GOSAL, Ludhiana.

Any attempt to make a detailed regional analysis of birth and death rates in India is greatly handicapped by the inadequacy of data. The figures, by states, here used for a broad regional survey are only estimates carefully prepared by experts.

There is an inverse correlation between birth rate and (i) nutritional density of population, (ii) degree of urbanization, and (iii) literacy, the degree of correlation varying within areas but valid in general. Compared with advanced countries, birth rate is very high in all parts of India. But with accelerating urban and economic development, progress of education and family planning, fertility rate will certainly decline. However, such a trend will have to face the counteraction of (i) increasing re-marriage widows, (ii) declining rate of maternity deaths, and (iii) the fact that such a large proportion of India's population is in the younger age-groups.

Death rate, which is still very high in India—27·4, is higher in regions suffering from the frequency of droughts, shortage of food-supplies, and epidemic outbreaks, and lower where either these risks do not exist, or effective measures have been taken against them. In general, there is a fairly strong correlation between birth and death rates.

120. Demorgraphic Features of the Kangra Valley.

V. P. KAYASTHA, Varanasi.

The uniform surface, the fertile soil and good climatic conditions have favoured the concentration of population in Kangra Valley.

The variation of population on the whole is positive. The growth of population is divided into three periods—1891-1901, 1901-1921, 1921-1951. The net variation is 14,974 persons in fifty years (1901 to 1951).

The density of population has increased from 250-350 in 1891 to 300-400 persons per sq. mile in 1951 because of more irrigation facilities, increase in cultivated area, tea and fruit gardens, development of communications and better medical facilities.

There is general correspondence between the population and the hydrographical map. The south of valley has dispersed population because of dissected topography. The north is mountainous and empty.

The area has peoples of diverse beliefs and customs. The Ghirths are perhaps the original inhabitants. The Rajputs and Brahmins have settled here from other parts of the province under conditions of political and social upheaval.

(vi) Regional Geography

121. A note on the Geographical aspects of Hukitola, Cuttack District, Orissa.

B. C. ACHARYA, Cuttack.

The region around Hukitola comprises part of the eastern-most point of the coastal fringe of Cuttack district, in Orissa. It has produced a small gulf with the main land which is being silted up rapidly and land formation is going on. So approach becomes difficult during low tides, practically from all directions.

The region has a pleasant oceanic monsoon type of climate. It falls in the track of tropical cyclones. Sometime severe cyclones pass over the area. The soil consists of silt, recent alluvium and sand, and the vegetation consists of a mangrove forest and tall grasses. There is hardly any permanent population and few crops are grown.

A study of this area reveals that there is scope for all round development specially of fishing industry, tourist industry, cocoanut plantation and bark collection from mangrove trees for tanning. Further, the importance of this area is likely to increase with the development of Paradwip port.

122. The Soils of the Tarai Region of Uttar Pradesh.

L. R. SINGH KANAUJIA, Allahabad .

The soils of the Tarai Region are quite immature and youthful, their immaturity being quite clear in the substantial proportions of undecomposed plant residue, and their youthfulness, in the high proportions of coarse sand which reaches as high a value as 26% in the fourth layer.

The Tarai is a zone of recently formed alluvium composed of the debris brought down by the streams from the Himalayas. This feature lends the zonal soils a homogeneous character. Climatic and biotic factors by their over-all similarity further work towards the same end. However, topography intervenes and reveals its distinctive character in bringing about long term changes in the soil morphology. As such, considering the general configuration of the region, three sample topographical types of soil can claim our attention :

(i) Soils of a Low-lying Riverine Topography (between the Great Gandak and the Little Gandak in Padrauna Tahsil, District Deoria)—Silty or sandy loam; generally low-lying, but fairly well-drained; "Calcium soils with a larger reserve of lime", locally known as "Bhat".

(ii) Soils of a sloping Topography (Barhmi Zone in Basti District)—Clayey loam texture and cloddy structure, highly suitable for cane and paddy cultivation.

(iii) Soils of a Flat but slightly Elevated Topography (Tahsil Baheri, District Bareilly—locally known as "Des" soils, clayey ("mar") soil type, calcium conspicuous by its absence.

The importance of scientific soil management, afforestation and regulation of land use in the Tarai, is emphasized. Proper manurial schemes should be adopted and caution should be exercised in the use of tractors, for there is likely to be rapid loss of organic matter if thin sandy loams are not treated properly. Further, the problem of soil erosion is becoming serious due to extensive forest clearing, overgrazing and unjudicious farm practices.

123. Indigenous irrigation in the Mahanadi Valley of Orissa.

BIJOYANANDA MISRA, Patna.

Indigenous irrigation works include tanks, wells, jhils, and jors which together irrigate about 83% of the total irrigated area. These sources have, however, a limited utility because they either dry up or have so little water left during summer that they become useless for irrigation. Irrigation in the valley is therefore highly seasonal. It is nonetheless of great importance, because firstly, the success of the highly profitable cash crops namely potato, sugarcane and betel leaves, and maize grown on the homestead lands entirely depends on it, and secondly, it considerably minimises the danger from the failure of rains in the critical months of September and October when the paddy crop requires adequate water to attain maturity.

Tanks are the most important source. They irrigate more than 60 per cent of area under irrigation and supply comparatively large quantity of water for a longer period of the year than the other sources. Physiography has an effective control in the distribution of the different sources of irrigation. While wells, jhils and jors are relatively evenly distributed throughout the valley, tanks are concentrated in the areas of low relief and undulating gentle slopes, especially in the west and south of the valley.

Wells are of greater importance than tanks in the cultivation of rabi crops, because tanks mostly dry up in summer. Hence in the tank irrigated areas rabi crops become relatively unimportant. Further, by the time the farmer harvests the winter paddy, little water is left in the indigenous sources to irrigate a second crop. Hence in areas where there is a great dependence on the indigenous sources of irrigation, double cropping is of little account.

124. The Soils of Orissa.

B. N. SINHA and S. N. MUKHERJEE, Calcutta.

The soils of Orissa have been studied extensively on the basis of the environmental factors like parent rock materials morphology, climate, vegetation and other minor factors. Broadly they are classified as, the soils of northern plateau, rolling uplands of Brahmani and Mahanadi, the Eastern ghats and the coastal plains.

In the northern plateau red soil predominates and at places it is admixtured with black soil. The yellow earth of Sambalpur and the black earth of Angul, Baudh, Jharsuguda and Aska are important soils of the rolling uplands of the Brahmani and Mahanadi. High level laterites occur in Koraput and Ganjam, and low-level laterites in the foot hill zones of Puri and Cuttack districts. The brown earth of Balliguda has developed because of the dense forest of *Shorea Robusta.*

The coastal alluvial soil is sub-divided into soils of northern (Budhabalanga), middle (Mahanadi) and southern plains (Rushikulya) where sandy to sandy loam, clay-loam to stiff clay and sandy loam are found respectively. A narrow belt of sandy saline soil is found within a few miles from the shore all along the Orissa coast. A small patch of swampy soil has developed in the "Little Sandarbans" of the Mahanadi and Brahmani mouths.

125. Irrigation in the South Ganga Plain of Bihar.

RAMESHWAR PRASAD SINHA, Ranchi.

South Ganga Plain of Bihar, lying between the Ganga and the Chota Nagpur Plateau and between Rajmahal Highland and the Karamnasa, presents four physical units :—(1) Southern Natural Levee of the Ganga, (2) Low-lying tract, (3) Gentle Up-rising Fat plain and (4) Hilly Fringe.

The land slopes from south to north towards the Ganga valley, with a gentle slope to the east. A number of streams feed the Ganga from the south. A stream parallel to the Ganga, is generated due to the natural levee and causes widespread flood in the low-lying tract, when the Ganga is full to the brim. The rain-fall of the region is highly seasonal, variable and uncertain.

The dry west has numerous canals, while the major plain tract is dotted with wells, tube-wells, 'Ahars, Pynes', tanks and ponds. The Sone and the Kharagpur canals irrigate about 8,83,832 acres. There are no less than 514 tube-wells, which irrigate 16,000 acres of land. The ordinary wells are about 2 lacs and irrigate about one acre each. "Ahar" tanks, ponds pyne etc. irrigate about 5,03,168 acres.

The area is sub-divided into ten river basins, and has number of irrigation schemes. 33 irrigation schemes have been completed up till 1957-58 and 10 schemes are under execution. They are expected to command an area of 6,57,180 acres. The total irrigated land after the Second Five-Year Plan would be 23,02,180 acres i.e. about 33 4 per cent of the total cultivable area.

The future of this agricultural tract lies in taming and training the streams and in repairing and on riviving the defunct 'pynes' and 'ahars'.

(vii) Land Utilization

126. Morphology and Utilization of the Floating Gardens of the Anchar Lake, Kashmir.

A. N. RAINA, Jammu.

This paper studies further corroborative evidences in confirmation of utilization of floating gardens with reference to Survey Sheet No. 43J, Latitude 34° N and 74° 45′ E, a typical depression of inland drainage in which the Sinsh, the largest tributary of the Jhelum, pours its clean cold waters.

A morphological study of the villages of Haran, Rakh Haran, Gund-i-Rahman, Anchar and Gadra reveal an interesting interplay of geomorphic features being shaped by the silting up of the northern shores of the lake of which the existing remnants are the Anchar Lake and the Shalbug *Numbul* (Swamp). The soil composition varies from deep alluvial deposits of sand and clay interstratified with coarse sand and gravel on the bank of the lake where swampy areas have boggy and carbonaceous soil. The *Numbul* is perpetually under water but is gradually shrinking in size as a result of silting up, thus adding profitably to the dry land. In this area terracing is prevalent where a modified form of contour farming is found.

Though not as vast an area under the floating gardens as in the Dal Lake, in the Anchar Lake grows a thick grass called "Pych" with its roots at the bottom which when intertwined make a hardy floating garden with a thick sill of compressed clay used for growing vegetables like cabbage, knol khol, radish, carrot and green pepper. A large area is used for growing lotus stalk (*Nadru*) a yellowish white vegetable taken both raw and cooked. Fresh vegetables and fish are carried in small boats generally paddled by single person thus reducing greatly the price of vegetables for which there is ready market to the South of the Anchar Lake at Srinagar. A population of about 3500 is energetically developing resources in this region. From dawn till dusk hundreds of sturdy fishermen move out in the Lake shooting geese and catching fish while women and children collect vegetables and willow for the market at Srinagar. Two *nalas* connect Srinagar with this area. The contour map shows the extent of land-use in this zone of interesting interplay of a complex morphology.

127. The local relief and land use in the Damodar Basin.

ADYA SHARAN, Patna.

An attempt has been made to represent the local relief on a map with a view to find out the relationship between the local relief and land use. For the proposed map, Smith's method of representing the relative relief was followed. Data of local relief were extracted from one inch to a mile sheets of the Survey of India, covering the Damodar basin. The resulting map delineates the areas of similar relief and shows the spatial relationship between those areas.

The areas of higher relief (above 500′) are scattered and found along the edges of the High Plateaus and flanks of the tangled mass of hills. They are rugged and wild and mostly left to forest, and in future planning should be exclusively left to forest. The areas of moderate relief (250′-500′) are fairly continuous and follow the rivers' courses. These are the rolling plains with occasional hills and ridges. Agriculture is the dominant occupation, which is dependent on soil-conservation devices. Here the waste land should be converted into forest which is likely to give better return than cultivation. The areas of low relief (below 250′) are plains occupying either the plateau tops or the flood plains. Agriculture is more profitable. Here all the waste land should be brought under the plough.

128. Changing land use pattern around Mirzapur Town, U.P.

VIJAYA RAM SINGH, Varanasi.

The area under study covers about 30 sq. miles comprising 52 villages and two urban centres, Mirzapur and Vindhyachal. The following physical units may be distinguished :—

(i) The Vindhyan hill strip in the south marked by 300′ contour, (ii) the Bhangar plain of older alluvium extending up to the south bank of the Ganga and (iii) the Khadar plain of newer alluvium being mainly confined to flood plains, north of the Ganga. The area is drained by Ganga and its tributaries. The ravines are noticeable along the middle and upper courses of the tributary streams.

The landuse pattern has considerably changed in the area since the beginning of the present century. The arable land has increased from 33·3% in 1906 to 51·2% in 1956, owing mainly to increased irrigation facilities, presence of population pressure on land, changes in land tenure and decline of cottage industries. The most spectacular increase has taken place on the Vindhyan hill strip following the introduction of canal irrigation in 1954. In the Bhangar plain most of the cultivable waste has been turned into arable land owing to the increasing pressure of population. The Khadar plain is frequently visited by floods which are responsible for the changes in landuse; when a thick veneer of sand is deposited, the area under cultivation decreases, but when a thick coating of silt is left the area under cultivation increases.

129. Orchard-arable-land-conflict in some selected villages.

R. N. P. SINHA, Patna.

Seven villages (total area 7 sq. miles) about 12 miles south-west of Patna and lying along the Kurkuri distributory of the Patna Canal have been selected for study. The extent of arable land has increased from about 33% of the total area in 1898 to about 86% in 1952, while between 1929 and 1952 the area under orchards has increased but slightly, and in fact shows a decline, if recent war-time plantations are ignored. Further, the number of trees in the orchards has greatly declined due to indiscriminate cutting. This shows that the provision of irrigation has merely led to the extension of arable land and little effort has been made by the farmers to grow fruit crops for which the elongated uplands formed by the levees of the westward shifting Son River, and the sandy and porous soil are eminently suitable and which would yield a higher income than even the irrigated triple-cropped arable lands as Patna and Dinapur would appear to provide attractive markets. The possible reasons appear to be the traditional preference of the farmer for the food crops, the reluctance of the high-caste agriculturists to sell the fruits for profit and danger of destruction from pests and diseases and from theft. Apart from being remunerative to the farmers, more orchards would mean better balance in land use providing vegetation cover, supplying leaves and wood for fuel and a valuable source of food, and adding considerably to the beauty of the landscape.

130. Land use pattern and agricultural planning in village Mahjuda, Tahsil Bhadohi, District Varanasi.

RAMA YAGYA SINGH, Varanasi.

The writer has conducted a sample survey of Mahjuda village in the Varanasi District of Uttar Pradesh. It lies on 82° 26′ E. longitude and 25° 25′ N. longitude. This hamleted village is situated in bangar area and lies along the kachcha road joining Suriyawan and Gopiganj market centres. It has a total area of 524 acres and a population of 872.

Loam, sandyloam and clay are the chief soil types. The cultivable waste, occupying 1/6 of the village area includes some Usarland as well as permanent and current fallow land. Arable land with double cropped area covers about 83% of the village area. Water features used for several purposes, are hygienically unfit. Jungles, occupying 1/12 of the village area, give fuel and fodder. Mango-groves are scattered in various parts of the village.

Division and fragmentation of land-holdings create serious problems. The cultivated land per capita is only 0·5 acre.

Agricultural practice depends mostly on four instruments—the plough, the clod crusher, the spade and the hoe. Wells are chief means of irrigation. Only a little chemical fertilizer is used.

Farmers do not follow any systematic crop rotation. Mixed and double cropping are common. There is no distinction between Rabi and Kharif croplands except the paddyland which occupies the northern and eastern clayee parts. Paddy and Bajra are the major Kharif crops, and barley, wheat and peas are the chief rabi crops. Crop failure due to drought is usual.

(viii) Urban Geography

131. Masulipatam—A Geographical appraisal of its changing role.

S. M. ALAM, Hyderabad.

Masulipatam shot up from oblivion to the position of a metropolitan port on the East Coast in the 17th century.

When the port of Goa was closed as an outlet for Golconda goods, the entire kingdom of Golconda became the hinterland of Masulipatam. Its direct link with the capital of the kingdom and good anchorage facilities enabled it to take over the role of Goa without any difficulty. Its rich hinterland, famous for diamonds, chintzes, steel goods and diverse other products catered to the needs of a vast geographical area. Its central location on the East Coast of India made it a focal point for the confluence of ships. The rise of Masulipatam as a port accidentally coincided with the expansion of the trading operations of the European nations along the East Coast. Towards the end of the century its commerce declined for political reasons.

With the emergence of the French as a political force on the East Coast, in the 18th century, the nascent strategic importance of Masulipatam came to the fore. Its possession by the French allowed them to have uninterrupted sway in the political affairs of the Deccan. Its fall into the hands of British forces turned the fortunes of Anglo-French war in India in their favour. Masulipatam controlled the life line linking it with Hyderabad. Control over Masulipatam also gave a virtual control of the rich Northern Circars. The British also fully appreciated its strategic importance in controlling the Deccan. However, with the change in operation bases its strategic importance also vanished by the middle of the 19th century.

Towards the latter half of the 19th century the linking by train, of Secunderabad to Bombay and Bezwada to Kakinada and Madras squeezed the hinterland of Masulipatam and diverted its trade and traffic to Bombay and Madras where large ocean-going vessels could call. The cyclonic storm of 1864 also dealt a shattering blow to its trade.

The formation of Greater Andhra Pradesh and the Five Year Plans have now changed the geographical factors. Masulipatam has an inherent geographical pull. Scientific land utilization and technology may again restore its commercial supremacy. Geographical factors are generally favourable and those unfavourable are neither insurmountable nor beyond economic limits.

132. Functional Zones of Murshidabad.

N. D. BHATTACHARYA, Varanasi.

Murshidabad (24° 12′ : 88° 17′), can be easily divided into three functional zones. The inner Geographical Zone corresponds to the administrative area which is governed by the Nizamat under the guidance of the Board of Revenue. There is another administrative area which lies to the south of the 'Pancharaha Bazar'. It includes the Lalbagh Sub-Divisional Court, Murshidabad Municipality and other Government Offices.

Two ribbon-shaped residential areas running almost parallel to the river Bhagirathi are : (1) From the Dakshin Darwaja (Southern Gate) of the Killah to Mahimapur, (2) Lalbagh area—bounded by the Berhampore—Jiaganj Road (old and new). The settlements, both for Hindus and Muslims, however, reveal that Murshidabad is at present more rural than urban in character. The outer zone consists of pukka (ruins) and kachcha houses scattered all over the area.

The Pancharaha Bazar—the main collecting and distributing centre of the area lies a little north of the Lalbagh Singhi Higher Secondary School. Another market has grown up at the Kurmitola Transit Camp area to feed the displaced persons of East Pakistan.

133. Influence of Industrialisation on Urbanisation in West Bengal.

MANORANJAN CHAUDHURI, Calcutta.

West Bengal is the most urbanised State in India. Urbanisation in the State has largely been due to the development of manufacturing industries and minnig activities. An attempt has been made in this paper to analyse the influence of industrialisation on urbanisation in West Bengal. Industrial erosion resulting from excessive concentration of population and industrial activities in urban areas is discussed. Regional planning and development of "green grid" is suggested for redevelopment of towns and cities and augmenting industrial production in the State.

134. The evolution of Jamshedpur.

P. DAYAL and L. N. RAM, Patna.

The principal factors determining the character and directions of the growth of Jamshedpur include (a) the Tisco works to which the town owes its origin and which forms its very heart and soul, (b) the location of the early rural settlements which provided nuclei for growth and which today constitute the most closely built up areas and the principal markets, (c) the ralway station which by attracting industries in its neighbourhood has caused the establishment of settlements away from the river banks, (d) the Subarnarekha and the Kharkai rivers which have created suitable site conditions and determined the external form of the settlement but which at the same time have retarded development along the banks on account of their low-lying character and liability to flood. The town has grown outwards from the central core of the Tisco works but on account of the limiting force of the railway line in the south, the resultant pattern of the zones of growth is semi-circular rather than circular. The initial differentiation between the factory and residential areas has been perpetuated by the development of factories in the vicinity of the railway in the east and the growth of residential areas in the west. This segregation of functions has led to avoidance of congestion by providing ample space for expansion in the respective areas. This has also saved the residential area from pollution and smoke, as the prevalent wind direction is westerly.

It is only partially true to say that the city is planned. Its powerful regional setting and rich resource base have so forced the pace of development that plans have always lagged behind the city, resulting in the growth of slum or near-slum areas (e.g. Jugsalai and Khasmahal) on the periphery, particularly south of the railway line, on the lands outside the control of the Tata factory.

135. Two Cities of Chota Nagpur.

HEM PRIYA DEVI, Ranchi.

Out of 138 cities of India, Chota Nagpur shares two namely Ranchi and Jamshedpur having grown under two different settings. Ranchi is the summer capital of the State of Bihar whereas Jamshedpur is its industrial capital.

Ranchi : The site of the city on the Ranchi peneplain forms a natural point of convergence of routes from everyside. From a village market, Ranchi has grown to a modern city and its significance has increased in the spheres of transport, business, administration, military affairs and education.

Dons and valleys are still empty spaces although such blanks seem to be filling up. Radial pattern of the roads from the hub of settlement spread like spokes and the Circular road forms the rim. Rectangular pattern of roads have developed over flat tanrs.

In this paper, the city has been divided into the following six functional zones : Business core; Educational Centres; Residential Zones; Transport, hospital, post-office, etc.; Recreational centres; Missionary centres.

In 1951 Ranchi enumerated as a slightly over million-size city, but with the development of new township in Kanke in the north and heavy machinery plant being set up with Soviet aid near Hatia in the South, Ranchi is bound to grow in size and number.

Jamshedpur : Jamshedpur is located as close as could have been possible to the sources of the chief raw materials for the steel plant. The Subarnarekha valley and the Sanjai-South Koel gap provide an access to Calcutta and Bombay. Having an extensive home and international markets, Jamshedpur has ever expanded.

The city is neat, open and symmetrical with well planned buildings, broad roads, parks and clubs. Jamshedpur has a marked segregation of functions and has little of congestion like other industrial centres. The eastern sector of the city—a projection of the industrial centre is occupied by residential buildings.

Besides the industrial zone, there are, business, residential, administrative, recreational, and other functional zones. Jugsalai forms a part of Jamshedpur but differs in planning. The density differs in different circles.

The city is growing to the north of the Subarnarekha and east of Tatanagar. The damming of the Garra, where it forms a gorge, may solve the water problem for the eastward extending settlement.

136. A critique of Town-plans of Jamshedpur.

ASHOK KUMAR DUTTA, Patna.

Various plans have gone into the making of Jamshedpur. The initial rectangular lay-out was prepared by Mr. Kennedy in 1911. The plan was unsuitable for the undulating topography of Jamshedpur. Mr. Temple's plan of 1920 took local topography into account. He designed his plan to develop Bistupur as the main centre of urban activity and Sakchi as a secondary centre. Mr. Stokes planned the city to house the workers in one mile radius from the TISCO works, and the officers in two mile radium. It resulted in the construction of some residential quarters east of the Works which has to face smoke and dust pollution due to regular westerly winds. His is an unscientific plan.

Mr. Keonisgsberger's plan of 1944 on which the present township is based, is based on the neighbourhood unit design. He separated factory and housing zones. He suggested the introduction of streets having different functions, which have not yet been implemented. The concept of neighbourhood unit is recent in origin. In some respects his plan is also defective, but he shows a better sense of perspective and more concrete imagination than his predecessors.

A new plan is needed for the city because (1) the total limit fixed in Keonisgsberger-plan for housing three lakhs of people is going to reach by 1960, (2) the city is likely to grow rapidly due to various factors, which would need more accommodation both for industrial and residential purposes, and (3) the present congestion as well as the likely sporadic growth has to be avoided.

137. The origin and growth of Kanpur.

UJAGIR SINGH, Varanasi.

One of the chief considerations in the foundation of Kanpur at the present site was the ease of defence. Its position formed the key of the border line dividing the then British frontier from the province of Oudh and also the territory of the Moghal Kings of Delhi. The defensive site accompanied with steep right bank and navigable channel of the Ganga led to its selection as the headquarters of the British forces in 1778.

The nucleus of the city was a small village. After the English troops were cantoned here, the village rapidly grew by the middle of the last century into a township containing nearly 60,000 inhabitants.

The city remained an important military centre till the uprising of 1857 after which the government with a view to providing permanent employment to the rebellious public decided to make Kanpur an industrial centre of the province. This was followed by the construction of several rail-routes and the Ganga bridge in 1875. Consequent upon these developments, tannery and leather factories, cotton mills, woollen mills, jute mills, sugar refinery works and chemical factories were established on the periphery of the city, first on the bank of the Ganga in the north and later in the south near the railway station.

Today, Kanpur has become one of the largest industrial centres of northern India supporting about 43% of its population on industries.

138. Evolution of urban landscape of Lucknow.

S. P. SINGH, Varanasi.

Lucknow lies on the bank of the river Gomti (26° 52′ N. and 80° 65′ E.) and has group up on both the banks of the river.

Its early history is shrouded in legends. The Fort perhaps formed the first nucleus for the development of the town. The central market Chowk and its surrounding areas grew up during the Moghals. But the designer and maker of modern Lucknow was Nawab Asafuddaula. He transferred Ayadh's capital from Faizabad to Lucknow. This stimulated the growth of the town considerably, and it was then that it was extended on both banks of the river. The Nawabs planned it as a 'Garden City'.

During the British period the introduction of Railway provided further impetus for the growth of the City; the areas in the neighbourhood of the Railways began to grow very fast and the Railway Colony was added. But its most vigorous growth followed the shift of some of the capital functions from Allahabad to Lucknow.

The paper concludes with a discussion of the different geographical zones of the city.

139. Growth of Mohania as a market centre.

KASHI NATH SINGH, Varanasi.

The paper studies the growth of village Mohania (25° 10′ N. and 83° 30′ E.) into a market centre in the heart of Bhabua sub-division, Shahabad (Bihar). Situated along the Grand Trunk Road and the Grand Chord of the Eastern Railway it enjoys a significant position in respect of the regional centres like Sasaram and Dehri, 29 and 41 miles respectively on the east, and Varanasi, 43 miles on the west.

The village was, in the words of Buchanan, a local military supply centre for the army in the medieval and early modern period, and provided 'safe lodgings' for pilgrims in the 'Sarai area' kept by 'Bhetiyarings'.

With the establishment of railway connection with eastern markets like Calcutta, Dhanbad etc., and the construction of roads in the neighbourhood, Mohania grew into an important grain collecting centre. During World War II it had 32 'Arhats' and exported 4 to 5 lakh maunds of grain annually. Since then, it has grown into an agro-industrial centre with over two dozen small mills of flour ,rice, oil and 'Dal'. Recently, it has become the headquarters of the Community Development Project with its various offices. The market has now over hundred shops and over a dozen godowns dealing in building materials like timber, cement, stone slabs, lime etc. All these developments have resulted in denser bus traffic, provision of health and educational services and varied amenities and a population increase from 2,500 in 1951 to 4,500 in 1957.

The study reveals that Mohania has sprung up as an inter-servicing point where the service-efficiency of the larger neighbouring centres are little felt, except for higher services.

140. Umland of Jaunpur.

HARI HAR SINGH, Varanasi.

Jaunpur (25° 45′ N. and 82° 41′ E.) lies on the bank of the Gomati, about 15 miles above its junction with the Sai, and 36 miles northwest of Varanasi.

The city being the headquarters of the district, naturally contains several administrative offices. It is an important educational centre having five intermediate colleges, one full-fledged Degree College and a recently established Polytechnic. Further it is noted for its wholesale grain markets.

The city depends on the surrounding areas to meet the requirements for the urban community. The neighbouring areas supply milk and vegetables but the grain and other food materials come here from longer distances. An attempt has been made here to determine the umland of Jaunpur with the flour supply zone and bus service zone, as the most significant criteria, as these determine the boundary of the umland more clearly than the other indices. The flour supply zone coincides with the milk and vegetable supply zone and determines the primary umland of Jaunpur covering an area of 4 to 5 miles in radius. The bus service zone coincides with the administrative, educational and medical service areas and determines the secondary umland of Jaunpur covering an area of nearly 20 to 25 miles in radius.

(ix) Political Geography

141. America's interest in Africa : A Geopolitical interpretation.

P. K. SIRCAR, Delhi.

The paper attempts a geopolitical analysis of America's growing interest in Africa. The implementation of the American foreign policy demands acquirement of some specific interests in Africa, which may be grouped under two broad heads : economic and strategic. America's needs and resources are examined in this context to reveal some disturbing gaps between her domestic production and her actual requirements. Some of these deficiences are met from African exports. The tempo of African economic development has increased enormously, one factor in this development being the American aid programmes. There is now an increased production and export of many raw materials; and transport, communication and port facilities are multiplying rapidly.

In view of her avowed anti-colonialism, she has to face a dilemma sometimes in her foreign policy in Africa. The maintenance and acquirement of strategic and economic interests in Africa often appear to be in conflict with African nationalist aspirations and sentiment.

The paper concludes with a note on Africa's strategic significance in view of its global location.

(x) Cartography

142. Some fundamental problems of population mapping.

SIVAPRASAD DAS GUPTA, Calcutta.

A few changes in some common mapping procedures have been suggested. In density maps generally the density value is expressed as number of persons per square mile or square kilometre. But this ratio is essentially derived from the total population and the total area of the administrative units. The density value is therefore extremely generalized and the value is not true for every square mile of the entire area. Since the degree of generalization depends upon the size of the administrative units, the common density maps have varying amount of generalization in different parts of the map area, due to the varying sizes of the administrative units. It is suggested that the density map should be constructed on the basis of the density values derived by cartographic method from detailed dot map for unit areas of uniform size adopted for this purpose. This unit area may be taken equal to 10 square miles or 100 square miles, whichever is plottable on the scale of the base map. The common terminology like "per square mile" should also be changed to "per 10 or 100 square miles or square kilometres" as the case may be.

The problems of the dot method as also the merits of the "Coin System" of dots which has been adopted for the preparation of the population map in the National Atlas of India, are discussed.

143. The Jabra Basin.

B. G. TAMASKAR, Amravati.

This paper incorporates a study of small region of 150 sq. miles in area. The Jabra basin is a good example of inverted topography. Structurally, it was a low dome in the Saugar-Damoh Plateau which, after subaerial denudation, has formed a basin. The relief, drainage pattern, climate and its vagaries, irrigation, agricultural crops and potentialities, distribution of population, size of villages, probable causes of desertion of village sites, classification of villages, house-types, building materials, means of communication and need for their improvement and expansion have been discussed at length. It also covers a detailed study of two regional centres of the basin, namely, Jabra and Singhpur.

SECTION OF BOTANY

President :—PROF. R. MISRA, M.Sc., Ph.D., F.N.I., F.N.A.Sc.,* F.B.S.

Abstracts.

(a) Algae

1. A case of true branching in genus *Nostoc* Vauch.

K. P. SINGH, Nainital.

A form of *Nostoc commune* Vauch., exhibiting true-branching, was collected from Windhyan Falls in Mirzapur District. The alga was growing among mosses on a moist slopy rock It was in the form of mucilaginous balls and also in the form of flattened expanses. It was preserved in 4% formalin.

The trichomes are much contorted within the colonial sheath. Cells are barrel-shaped and measure 4·4-5·4 μ in breadth and 5·4-7·7 μ in length. Heterocysts are generally intercalary but lateral and terminal ones are also present. Terminal heterocysts are formed at the tips of the branches only. Lateral heterocysts arise due to lateral displacement of some of the intercalary heterocysts.

During reproduction most of the vegetative cells of the trichome become much enlarged and are filled with highly granular contents. Some of these differentiated cells germinate *in situ* and a row of paired cells is formed. Mostly these cells divide transversely but some of them, which do not find space to do so, bulge out laterally and get partitioned by longitudinal wall into a small cell which divides and redivides transversely and ultimately forms a true-branch. True-branches are of a rare occurrence.

2. A new *Selenastrum* from Nainital.

K. P. SINGH, Nainital.

An interesting form of *Selenastrum* was collected from a water-reservoir in the vicinity of Nainital. It was present almost in an unialgal culture except with a few isolated cells of a *Carteria* species. The alga was collected periodically and was always examined in living condition. Potassium-iodide and iron-alum-haematoxylin were used to ascertain the presence of pyrenoids.

The cells are lunate with rounded poles and always occur singly. Cells are 5·1-7·6 μ long and 2·4-3·5 μ wide. Young cells contain a laminate chloroplast without pyrenoids and that usually lies on the concave side of the cell. During reproduction the cells are considerably enlarged and become filled with diffused protoplasts. Protoplast divides by successive bipartition into four daughter protoplasts, which are eventually metamorphosed into four autospores. The autospores are liberated by the gelatinization of the parent cell wall.

The present alga differs from all other described species of *Selenastrum* in small size of the cells; in the presence of the chloroplast on the concave side of the cell; in the absence of pyrenoids and in the occurrence of cells singly. From these facts, as referred to above, the present form seems to be a new species of the genus *Selenastrum*.

3. Germination of akinetes in *Hormidium subtile* (Kütz.) Heering.

K. P. SINGH, Nainital.

Hormidium subtile (Kütz.) Heering was collected in August, 1957 and again in July, 1958 from shallow depressions on the surface of an exposed rock in the vicinity of Nainital. The present account of germination is based on the materials collected from the nature. Attempts to germinate them in soil-water medium were not successful.

During germination the protoplast of a germinating akinete becomes fairly enlarged, perhaps, due to absorption of water. The enlarged protoplast devides transversely, recalling the akinete and heterocyst germination of some of the Cyanophyceae. Two daughter cells thus formed divide again and a small four-celled filament is obtained. Germination of akinetes beyond four-celled stage was not observed. The presence of large number of short filaments and abandoned akinete walls, however, clearly indicate that further development beyond four-celled stage takes place only after their liberation from the akinte wall.

Germination of akinete in Genus *Hormidium,* to the best of writer's information, has not been reported so far. The present account, therefore, is the first record of such an event in this genus.

(b) Fungi

4. Some ascosporic moulds of Varanasi.

R. S. DWIVEDI, Varanasi.

This paper deals with these ascogenous fungi isolated at different depths from a grass land soil. The pH and moisture content of the soil have been recorded.

Aspergillus montevidensis Talice and MacKinnon of Glaucus group was isolated at 1-6" depth. Its characteristic features have been described in detail. It is a new record from India.

Aspergillus variecolor (Berk. & Br.) Thom and Raper was isolated at the depths of 1-6" and 7-12". Moreover the same fungus has also been collected in its perithecial stage on moribund leaves of *Agava* from the Botanical Garden, Banaras Hindu University.

Penicillium javanicum Van Beyma of the monoverticillate group was isolated at 1-6" depth. Van Beyma neither reported any irregularities in the spore surface nor gave any indication of an equatorial line on the ascospores. Moreover he did not mention the presence of eight spored asci. But later on Raper and Thom reported these characters in this fungus. The author's findings on this fungus are in agreement with those of Raper and Thom. Further, the fungus in question differs from all the previously described strains in having large perithecia and in occasional occurrence of large conidia. Undoubtedly it is a new strain not reported so far.

5. Some new records of soil fungi in India.

R. S. DWIVEDI, Varanasi.

The soil fungi at different depths from a plot of *Desmostachya bipinnata* Stapf. grass-community were studied by dilution-plate method of Waksman supplemented by Warcup method. Peptone-Dextrose agar medium with rose bengal (Martin, 1950) was selected for isolation of these fungi. Twenty five species belonging to sixteen genera were isolated. Six species viz., *Mucor oblongisporus* Naumov., *Aspergillus japonicus* Saito., *Stysanus medius* Saccardo, *Colletotrichum falcatum* Went., *Epicoccum duriaenum* Mont., and *Humicola* sp., which have been described in detail, are reported for the first time from the Indian soil. *Epicoccum duriaenum* Mont. has been newly reported from soil.

6. Soil fungi from Cuttack.

GOURI RANI GHOSH, Cuttack.

In the recent years soil borne fungi have received much attention all over the world. India is not an exception and they have been reported from different states. So far nothing has been reported from Orissa. The aim of the present paper is to report some fungi which have been isolated from soil samples of Cuttack city.

Cuttack is situated between the 20·48′ N latitude and 85·56′ E longitude. It is a city of approximately 23 square miles It is bounded on its 3 sides by the river Mahanadi and its branch the Kathjori. The ground level of the city is almost equal to that of the river beds. In general the soil of the city is sandy loam but also alluvial at certain places. The climate is tropical and the average annual rainfall is 43 inches.

The following fungi have been isolated from six different sources of soil samples from different corners of the city. Of these *Aspergillus niger* V. Tieghem was the most common fungus encountered, *Aspergillus flavus* Link was the next. Most of these fungi have been reported previously from India but those asterisked are new additions.

The fungi isolated :

1. *Aspergillus niger* V. Tieghem.
2. *A. carnius* (V. Tiegh.) Blochwitz.
3. *A. nidulans* (Eidam) Wint.
4. *A. repens* (Cda) DeBary.
5. *A. chevalieri* (Magnin) Thom & Church.
6. *A. flavus* Link.
7. *A. flavipes* Bainier & Sartory.
8. **Penicillium citrinum* Thom.
9. *Spicaria divaricata* (Thom) Gilman & Abbott.
10. **Pullularia* sp. Berkhout.
11. *Curvularia lunata* (Walker) Boedjin.
12. **Fusarium nivale* (Fries) Cesati.

7. Some Myxomycetes from Cuttack (Orissa).

GOURI RANI GHOSH, Cuttack.

On the bank of the river Mahanadi fire woods are annually stored and stacked by the dealers for future distribution in the market. These woods are imported from various parts of the state and are transported through the river. These are exposed to rain and sun all the year round. On some of the old rotten stocks of the previous years, beautiful slime moulds make their appearance after the heavy showers of the rainy season. Every year collections are made from these places during the months of July to September. A number of them have been identified as follows and are being reported for the first time from Orissa.

Exosporeae.

1. *Ceratiomyxa mucida* Schroet, var flexuosa.

Endosporeae.

2. *Trichamphora pezizoidea* Jungh.
3. *Physarella mirabilis* Peck.
4. *Physarella mirabilis* (*Trichamphora oblonga* Berk & Curt.
5. *Physarum compressum* Alb & Schw.
6. *Physarum calidris* Lister.
7. *Badhamia hyalina* Berk.
8. *Stemonitis splendens* Rost. Mon.
9. *Stemonitis smithii* Macbride.
10. *Arcyria punicea* Pers.

8. Botryodiplodia on Tapioca Roots.

B. PADHI, Cuttack.

Samples collected from a decaying heap of the tuberous roots of *Manihot utilissima* Pohl., the tapioca plants, from a private garden in Cuttack in the month of August 1958, show conspicuous black globoid pustules up to 3 mm. in diameter. The pustules consist of a large number of confluent pycnidia, at different levels, opening outside by means of papillate ostioles which give the pustules a squamosous appearance.

The pycnidia are botryose-confluent, erumpent, stromatic membrano-carbonous, of variable size reaching up to about 400μ in diam. The conidiophores are inconspicuous and simple. The mature conidia are brown, smooth, oval 11-16-19μ long and 7-10-12μ broad, two celled with the partition in the middle.

The fungus is identified as *Botryodiplodia maniholicola* Petrak., which has neither been apparently yet reported from Orissa nor on the tapioca roots.

9. Survey of Antifungal Actinomycetes occurring in Indian Soils—V.

ASHALATA PAL, S. L. CHAKRABARTY, P. M. NAHA and P. NANDI, Calcutta.

A number of Actinomycetes strains were isolated from 20 soil samples collected from different parts of India. These were tested for their antifungal properties against the following test fungi—*Curvularia* sp., *Alternaria solani, Fusarium vasinfectum* and *Aspergillus niger*—using both Agar-cross streak and Agar-cup methods of assay. Of the 237 strains isolated, 18 showed activity against at least one of the test fungus, 25 against two, 13 against three and 6 against all the four test fungi. The rest of the isolates didn't exhibit any antifungal property. The selection of the test organisms was based on pathogenic types. Quite in conformity with the earlier workers, it has been found that a few strains, though showed inhibition zones in Agar-streak method, failed to do so in final screening in the Agar-cup method of assay. The following strains seemed to be promising in antibiotic production—Ac_2-^{432}, $Ac_{21}-^{460}$, Ac_8-^{101}, and Ac_1-^{465}. Further work is in progress.

An interesting observation was made while working with the coastal saline soil (pH—8·5) of Port Canning, 24-Parganas, West Bengal. The actinomycetes occurred scantily in these soils.

10. Notes on certain gastromycetes of Ahmedabad.

T. ANANDA RAO, Dehra Dun.

In the course of studies on the higher fungi of Ahmedabad and its environs the writer collected many interesting species of higher fungi previously not reported from this region. They were collected during the monsoon months of 1953-56.

The interesting collection includes species of *Tulostoma, Podaxis, Geastrum* (the specific identity would be published later), *Lycoperdon pusillum* Pers., *Sphaerobolus stellatus* Tode ex Pers., *Calvatia lilacina* (Mont et Berk) P. Henn, *Cyathus striatus* (Willd) Pers. and a new record of *Itajahya galericulata* Moller.

They were collected during the monsoon months of 1953-55 and are here described fully with notes on their morphological features and habitat.

11. A new species of *Lacellinopsis* (*L. desmostachyæ* sp. nov.).

R. Y. ROY and R. S. DWIVEDI, Varanasi.

In this paper a new species of the genus *Lacellinopsis* collected on the dead leaves of *Desmostachya bipinnata* Stapf. has been described in detail. The characteristic features in which this new species differs from both the previously described species viz. *L. sacchari* Subramanian and *L. levispora* Subramanian, are (1) the presence of proliferation of sterile setae into sterile ones through capulate apices, (2) occurrence of branched conidiophores and (3) presence of proliferation of conidiophore into sterile seta or secondary conidiophore.

12. Studies on the genus *Stauronema* Syd. and Butl.

R. Y. ROY and R. S. DWIVEDI, Varanasi.

Recently a pycnidial fungus was collected on dead leaves of *Vetiveria zizanioides* Nash. The fungus has conidia mostly with three setae, one at each and one in the middle on the convex side. Variations in the number and position of setae were also seen which are (i) one seta at each end and one on either side in the middle; (ii) two setae at one end, one seta at the other end and one on each side in the middle; (iii) one seta at each end and two on the same side in the middle; (iv) one seta at one end and one on either side in the middle; (v) one seta at each end, two on one side and one on the other side in the middle. Previously the genus *Stauronema* was considered as a sub-genus of *Dinemasporium* Lev., under which two species viz , *D. cruciferum* Ellis and *D. platense* Speg. were described. Later on Sydow and Butler (1916) gave a generic rank to this fungus and these two species were named as the species of *Stauronema*. They also described a new species *S. sacchari* on the culms of *Saccharum officinarum* L. Assigning the present fungus to the genus *Stauronema* is unwarrented, for the number of setae and their disposition on the conidia are not as described for *Stauronema*. Since the conidia are mostly with three setae the fungus may be considered as a new genus between *Dinemasporium* and *Stauronema*. In case there is any difficulty in creating a new genus on account of the fact that conidia with 4—5 setae are also occasionally present which go in favour of retaining it in the genus *Stauronema*, a new species of this genus be created. The authors propose to suggest the name of the fungus later on.

13. Occurrence of *Tetraploa* in India.

R. Y. ROY and M. SHUKLA, Varanasi.

This paper deals with the description of a species of *Tetraploa,* unreported so far from India. It was found on the leaves of *Bothriocloa* sp. collected from Kusmhi Forest, Gorakhpur. Conidia consist of 3--4 columns of cells with large setose appendages almost the size of the spores brown in colour, thick walled, smooth.

Only five species of *Tetraploa* are known and the present one differs more, than resembles, with *T. ellisii.* Cooke. Exact species will only be determined after cultural studies are completed.

14. Antibiotic-producing actinomycetes from the soil and compost collected from India Botanical Garden, Shibpur (Howrah).

NARENDRA NATH SHEE and P. NANDI, Calcutta.

Seven soil samples collected from the India Botanical Gardens, Shibpur and plated out in differential media. Of the 90 isolates there were 38 positive strains of actinomycetes. Their antibacterial and antifungal potency were tested against the following test organisms. *Stap. aureus, E. coli, Eb. typhosa V. chalereae; Alt. solani, F. vasinfectum, Curvularia sp.* and *Asp. niger.* It was found that among the isolates there are 4 broad-spectrum antibiotic producing strains and the rest possessed moderate to low antibiotic properties.

15. Helotiaceae of the Mussorrie Hills—II.

K. S. THIND and PRITAM SINGH, Amritsar.

This paper deals with three new species of Helotiaceae collected from the Mussoorie Hills during 1956-57. Their chief diagnostic features are :—1. *Midotis* (sp. nov.) characterized by the dark apothecia vertically elongated on one side, and also by the medulary layer of subhyaline to brown hyphae in the exciple. 2 *Helotium* (sp. nov.) which differs in small asci and ascospores from species of Helotium found on Quercus leaves, such as *H. sparasum* Boud. and *Pezizella jaapii* Rehm. 3. *Rutstroemia* (sp. nov.) which resembles *R. petiolorum* (Rob.) W. L. White (*Calycina petiolorum* (Rob. Seaver) and *R. sydowina* (Rehm) W. L. White, both of which occur on petioles of oak leaves but is not quite like either of these species. It is characterized by yellowish-brown, smooth apothecia (2·5-7 mm. in diameter) on dead oak twigs, 1-2 pseudoseptate ascospores and paraphyses not enlarged terminally.

16. The Pezizaceae of the Mussoorie Hills—VII.

K. S. THIND and PRITAM SINGH, Amritsar.

Four new species of Pezizaceae collected from the Mussoorie Hills during 1956-57 are described here : (1) *Lamprospora* (sp. nov.) characterized by yellow, large apothecia (–5 mm. in diameter) and smaller and uniguttulatte ascospores (9·7–11·2μ in diameter). (2) *Humaria* (sp. nov.) marked by verrucose ascospores rather than truly reticulate, with warts arranged in lines but connected in a network of ridges or crests. It is similar to *H. cubensis* (B. & C) Seaver but possess larger apothecia and smaller ascospores. (3) *Ascophanus* (sp. nov.) which is similar to

A. Granulatus (Bull.) Speg. but its spores are much smaller and are marked by longitudinal bands or striations. No species of *Ascophanus* is reported to possess such striated spores. (4) *Humarina* (sp. nov.) characterized by stipitate apothecia. No species of *humarina* is reported to possess stipitate apothecia.

(c) Bryophyta

17. Genus *Chiloscyphus* Corda *Emend.* Schiffner and *Heteroscyphus* Schiffner from India—I.

S. K. PANDÉ, RAM UDAR and V. B. SINGH, Lucknow.

The genus *Chiloscyphus*, with a cosmopolitan distribution, is well-known through its widely distributed species, *C. polyanthus* (L.) Corda. Stephani (1906, 1917-24) recognizes 175 species in this genus and 11 of these, viz., *C. argutus, C. coalitus, C. perfoliatus, C. flaccidus, C. inflatus, C. gollani, C. himalayensis, C. communis, C. gammianus, C. polyanthus* and *C. campanulatus* occur in India (Mitten, 1860; Stephani, 1906, 1917-24, Kashyap, 1932, Chopra, 1943). From a critical analysis of *Chiloscyphus* Corda, Schiffner (1910) recognized two distinct taxa :

(1) with *intercalary androecia* on main stem or on side branches and with perigonial leaves largely similar to vegetative leaves, and

(2) with *terminal group* of *androecia* arranged spicately and borne on branches arising laterally from the angles of amphigastria and with perigonial leaves different from sterile leaves.

The former has been retained by him (Schiffner, 1910) under the old genus *Chilosyphus* (Corda) *emend.* Schffn. while the latter was transferred to a new genus *Heteroscyphus* Schffn. Schiffner's new genus has been recognized by several hepaticologists (Verdoorn, 1932, Buch, Evans and Verdoorn, 1937 and Evans, 1939). Judged from the concept advanced by Schiffner (1910), four of our species, viz., *C. argutus, C. coalitus, C. communis* and *C. perfoliatus* belong to *Heteroscyphus* and the rest to *Chiloscyphus* except *C. inflatus* which, in character of cells in the leaf and the amphigastrium and in its overall appearance, is significantly different from either *Heteroscyphus* or *Chiloscyphus*.

The present communication is based on "PANDÉ COLLECTION" from specimens collected by Decoly and Schaul from Darjeeling and its neighbourhood and sent to one of us (Pandé) by the late Prof. V. Schiffner, Pfleiderer's collection of Western Ghats; Fr. Foreau's collection from S. India and our own collections from several parts of the country. A key for the identification of all the species known from India along with a detailed illustrated account of *C. polyanthus, C. campanulatus, H. argutus* and *H. coalitus* is included in this paper.

18. *Jamesoniella microphylla* (Nees) Schffn. new to Indian Flora.

S. K. PANDÉ, RAM UDAR and V. B. Singh, Lucknow.

Jamesoniella Spr. is a genus with a wide range of distribution and is primarily confined to the southern hemisphere including the Indomalayan region. It is also represented in North America and Europe by *J. autumnalis* (D.C.) St. and some other species.

From India Stephani (1906) described *Jamesoniella elongella* (Tay.) St. from the Himalayas. The same species was subsequently collected by Kashyap (1929) from Dalhousie, Kumaon Himalayas. In our flora the genus has so far been represented by this single species.

An examination of hepatics from South India kindly placed at the disposal of one of us (Pandé) by Fr. Foreau, has revealed the presence of *J. microphylla* (Nees) Schiffn., a species previously known from Java, Sumatra, Ceram, Ternate, Celebes, Ceylon and China. Its discovery from India not only extends the range of distribution of this species but also shows an interesting distribution pattern in being mainly confined to Indo-malayan region including China and neighbouring Islands.

As stated by Stephani (1906) the species is characterised by the presence of entire involucral leaves and is thus distinguishable from its closely related taxa. The specimens from South India are fertile and details of taxonomic features along with illustrations have been included in the paper.

(d) Gymnosperms

19. Studies on Foliar Sclereids in Gymnosperms (A preliminary Survey).

T. ANANDA RAO, Dehra Dun.

In this preliminary survey an attempt is made to work a detailed investigation of the sclereid morphology of a few genera of Gymnosperms, viz., *Araucaria, Agathis, Podocarpus* and *Gnetum* with a view to find out the importance of well defined morphological types of sclereids and their utility in the identification of sterile material.

20. Time relations in the development of the archegenium and embryo in *Cedrus deodara* Loud.

CHHAYA ROY CHOWDHURY, Delhi.

The Himalayan cedar or deodar, *Cedrus deodara,* is distributed throughout the Western Himalayas at an elevation of 4000 to 10,000 ft. The life cycle is completed in about 18 months.

The development of the archegonium begins in the second year around the fourth week of April. Three to five archegonial initials appear at the micropylar end of the female gametophyte. The development follows the usual course known in the Pinaceae. From the second to the beginning of the fourth week of May, depending on the altitude and the location of the tree, the archegonium is ready for fertilization. It consists of a multicellular neck- usually not more than two cells high, a small ventral canal cell, and the large egg cell.

Fertilization takes place in the latter half of May. The zygote divides twice and the four daughter nuclei migrate to the base of the archegonium. Further divisions followed by wall formation result in 16 cells arranged in four tiers of four cells each—embryonal, suspensor, rosette, and open tier. Embryos are formed from the first and the third tier only. The rosette embryos are ephemeral and abort early. Eventually, only one embryo reaches maturity. The embryo has 9 to 12 cotyledons and matures by December, i.e., seven months after fertilization. The seed is shed at the same time.

21. Some observations of the life history of *Pinus wallichiana* Jack.

R. N. KONAR and SUNDRI RAMCHANDANI, Delhi.

The male cone of *Pinus wallichiana* represents a modified dwarf-shoot. The wall of the microsporangium comprises the epidermis, two middle layers and the glandular tapetum. The pollen is shed at the four-celled stage. The cones are usually initiated in November, reduction divisions are over by April, and depending upon the altitude shedding occurs in May-June.

A pair of ovules is borne on each ovuliferous scale of the female cone which is a modified long-shoot. The ovule is unitegmic and crassinucellar. The development of the gametophyte is monosporic and in the first year the functional megaspore undergoes only a few free nuclear divisions. Pollination takes place in early May. Germination follows and the tube nucleus passes into the tube, but no further development occurs. Activity is resumed in February and the generative cell divides to form the stalk and the body cells which migrate into the pollen tube. Just before fertilization (in May) the tube contains two unequal male nuclei enveloped in a common sheath of cytoplasm, tube nucleus and the small stalk cell.

Free nuclear divisions continue in the female gametophyte towards the end of January and continue till April. Cell formation begins in May and two archegonial initials differentiate at the micropylar end. They enlarge slightly and each divides forming the neck initial and the central cell. The former divides again resulting in four cells which constitute the neck. The central cell divides to form an ephemeral ventral canal cell and the egg cell.

Fertilization takes place in the third week of May. The zygote divides twice and the four free nuclei migrate towards the tip of the egg cell. Subsequent divisions form the usual four tiers of four cells each—the embryonal, suspensor, rosette and open tier. Numerous embryos are initiated but ultimately only one of them reaches maturity.

The seed coat shows three distinct zones—the outer fleshy, the middle stony and the inner fleshy zone.

The life cycle of *Pinus wallichiana* is completed in approximately 36 months: the initiation of the male cones takes place in November; female cones in January-February; pollination in May-June (first year); fertilization in May (second year); and shedding of the seeds in October-November (third year).

22. Seasonal variations in the shoot apex of *Cephalotaxus drupacea* Seib. & Zucc.

HARDEV SINGH, Delhi.

The lateral shoot apex of the female plant shows distinctive morphological features at four different periods of the year: (1) *The resting period* (middle of December to the third week of February). The apex is inactive and is surrounded by dormant leaf primordia which in turn are enveloped by many scales. It is relatively high (109μ) and broad (207μ), and is distinguishable into four cyto-histological zones. The cells are poorly cytoplasmic and have thick walls. A plate of conspicuously thick walled cells ("crown") is present at the base of the bud. (2) *The bud elongation period* (end of February to the beginning of April)—The young shoot elongates and the apex becomes markedly narrow (90μ high; 120μ broad). The zonation is not well marked and the apical meristem is inactive. (3) *The bud scale formation period* (middle of April to the middle of July)—The apical meristem becomes active, produces numerous bud scales and increases in size (94μ high; 174μ broad), but becomes very narrow and small (36μ high; 123μ broad) by the end of this period. (4) *The foliage leaf formation period* (end of July to the beginning of December)—The apical meristem is very active and all the leaf pairs (20—24) differentiate. The apex reaches its maximum size (163μ high; 251μ broad) by the middle of October and is later followed by a decline till the resting period. The "crown" develops about September and the zonation pattern remains very distinct. The number of cells and layers of different zones increase while the cell walls become thin.

Despite some variations in the apical meristem, the basic cellular pattern remains the same throughout.

23. Occurrence of Archegonium complex in Ephedraceae.

NIRMAL NARANG, Hyderabad.

In spite of the fact that the developmental study of many species of *Ephedra* has been made in the past, it is surprising to find the absence of any report on the formation of archegonium complexes. Presently the occurrence of archegonium groups at the micropylar position in 6 species of *Ephedra E. sinica, E. americana, E. campylopoda, E. torreyana, E. distachya and E. alte* have been traced. In the first two species, *E. sinica* and *E. americana* the complex consists of only 2-4 archegonia which lie in immediate contact with one another. In *E. campylopoda* the number of archegonia varies from 2-8 and they showed various transitional stages in the formation of a complex. The weakly developed complex of 3-4 archegonia had a common jacket layer, but the intervening jacket layers between different archegonia had not completely disappeared. In other prothalli a perfect complex with no intervening cells consisted of 7-8 archegonia. The archegonia may also be arranged in two files, and the inner one lacked the usual neck. In *E. torreyana* and *E. distachya*, 4-8 archegonia aggregate to form a complex with no intervening jacket cells. In *E. alte*, the complexes are compact and perfect. There is no layer of jacket between the archegonia and a group of 2-8 archegonia is surrounded by a weakly developed common jacket. Often the archegonia of a complex fuse to form a common mass, "syn archegonium" structure. The egg and ventral canal nuclei of "syn archegonium" get irregularly disposed. This peculiar phenomenon had not so far been referred in any other gymnosperm.

Among other gymnosperms the formation of archegonial complex is a feature of Cupressaceae and Taxodiaceae. The archegonial complexes of Ephedraceae differ from those of Cupressaceae and Taxodiaceae by having less number of archegonia and its unconstant occurrence.

(e) Angiosperms

24. Investigations on coherent double-leaves in Corchorus olitorius L.

RABINDRA KRISHNA BASU, Calcutta.

Various kinds of aberrant plant growths were induced in three varieties of *Corchorus olitorius* L., namely, *Chinsura Green, R-26* and *Tall Mutant* by irradiating the seeds with radiophosphorus. An apparent single petiole arising from the point of bifurcation of stems was found to bear two laminae, in which the mid-ribs were united by their dorsal surfaces upto one third the length of the blades from the base of the laminae. The number of a stipules in such leaves varied from two to four. Anatomical studies of such abnormal leaves, called the double-leaves were made after serial transverse sections were cut from the base of the conjoint petiole till the blades became free, with special reference to the course of the vascular bundles. Anatomical studies revealed two groups of three collateral vascular masses each—one median and two laterals in each group. Gradually upwards, the fusion of the median and one lateral vascular mass on each side took place, which was followed by an exchange of vascular elements between the two groups of vascular masses. Later the vascular bundles on each side appeared 'V' shaped and were turned back to back. By the union of the free ends of the 'V' bundles, two rings of vascular bundles were formed, one on each side. Two inverse strips of vascular masses were cut off on each side from a 'V' bundle. By gradual reorientation, the inverse strips fused with the main vascular mass and from which the mid-rib and two main lateral ribs of a lamina were formed. From morphological and anatomical studies, such a feature was concluded to be a congenital fusion of two leaves.

25. A note on some floral abnormalities in a cultivated *Gaillardia* Sp.

M. N. GUPTA, Agra.

Floral abnormalities in the cultivated species of *Gaillardia* were studied. In certain heads along with the normal flowers many abnormal flowers were also present. These flowers showed increased number of sepals, petals, stamens and also of stigmas. The number of sepals was found to vary from 6 to 8 and that of petals from 6 to 9. Generally the number of stamens was equal to the number of petals but in few cases the number was either less or more. The stigmas also showed great variations in their number which varied from 3 to 8.

Incomplete fusion of two flowers was also observed in some cases. The corresponding whorls of calyx and corolla in the fused flowers united to form common whorls, while the stamens and the carpels remained free, forming two distinct groups.

In still another case it was observed that in a single ovary, two anatropous ovules were present.

26. Studies in the germination of seeds in relation to the evolutionary tendencies of the compound leaf.

S. SANKARAMURTHY and M. S. KARUNAKARAN, Annamalainagar.

A study of the following 15 species of plants spread over 9 families has been made with a view to find out the possible relationship between simple leaf and compound leaf : (1) *Crataeva religiosa* Forst. (Capparidaceae), (2) *Cleome viscosa* Linn. (Capparidaceae), (3) *Cleome aspera* Koen. (Capparidaceae), (4) *Gynandropsis pentaphylla* D.C. (Capparidaceae), (5) *Azadirachta indica* A. Juss, (Meliaceae), (6) *Sapindus emarginatus* Vavil. (Sapindaceae), (7) *Cardiospermum helicacabum* Linn. (Sapindaceae), (8) *Odina wodier* Roxb. (Anacardiaceae), (9) *Cayratia cornosa* Geg. (Vitaceae), (10) *Moringa oleifera* Lam. (Moringaceae), (11) *Cosmos* sp. (Compositae), (12) *Lycopersicum esculentum* Mill. (Solanaceae), (13) *Millingtonia hortensis* Linn. (Bignoniaceae), (14) *Bignonia megapotamica* Spreng. (Bignoniaceae), (15) *Dolichandrone stipulata* Benth and Hook. (Bignoniaceae).

For this purpose the developmental stages of the leaf were observed right from the germination period of the seed till the formation of the full fledged adult plant. In the majority of cases every leaf which destined to become compound later in the adult condition commences as a simple structure. In other words the first formed leaf is invariably simple. Very often the manner of derivation of a compound leaf from a smiple leaf is suggested by the appearance of lobations in the entire blade of the juvenile leaf. It is only by the deepening of these lobations up to the petiole or to the mid-rib as the case may be that ultimately a typical compound leaf is derived. Thus in the very ontogeny of the leaf, we have indications of its evolutionary history, thus confirming Haeckel's dictum that ontogeny recapitulates phylogeny.

Another revealing fact is that the paripinnate leaf is the derivative from an imparipinnate leaf through the suppression of the terminal leaflet.

27. Vegetative Propagation of high Quinine yielding Cinchona Ledgeriana, Moens.

SALIL KUMAR CHATTERJEE, Darjeeling.

1. In the present investigations the possibilities of the methods of Patch-budding and Cinturing have been reported. The investigation is being followed in order to build up clonal strains from trees charaterised by high quinine content and vigour.

2. The method of Patch-budding consists in removing a patch of bark from the stem of the plant (called root stock) on which the budding is to be done and deplacing it with a similar sized patch of bark with a bud in the centre obtained from the shoots of the high quinine yielding tree intended for propagation (called scion) and bandaging the operated parts with alkathene. The inserted bud is later forced to grow by top-trimming.

3. In Cinturing the shoots of high Quinine yielding Cinchona tree are girdled just below a node about 3″ below the tips. The shoot is then etiolated with moss and dried banana sheath—leaving 2 pairs of youngest leaves at the tip. Roots appear, provided all conditions are satisfied, at the girdled region.

4. The monthly trials on patch-budding shows success during February to June—particularly in the months of April and May. During these months, the sprouting of buds (introduced from high quinine yielding trees) are more rapid and the growth of shoots developed therefrom is more vigorous.

5. The monthly trials on rooting of cintured shoots show the clear influence of Indole butyric acid on hastening the formation and development of roots. During the months under observation, March-April-May show best response.

6. Detailed investigations in the various problems relating to patch-budding and cinturing are in progress and will be reported elsewhere.

28. Veinlet termination number as a criterion for the identification of leaf drugs of the Indian Pharmacopoeia.

S. C. DATTA, Calcutta

Veinlet terminations are the small veinlets, termed as bundle ends, which project into the area of vein-islets and terminate there. It has been observed that the number of these veinlet terminations per square millimetre of leaf is a constant feature of the species and it is independent of the area of the leaf and is not significantly dependent on the position at which it is determined. It has been used to differentiate coarse powders of certain leaves belonging to co-generic species and the above observations have been applied in the present paper to bring out the veinlet termination numbers of 15 leaf drugs of the Indian Pharmacopoeia, so that they could be used as identifying criteria.

These numbers for the species studied, are stated below. *Eupatorium tripli-nerve* Vent (5·5); *Atropa belladonna* Linn. (3·0), *Swertia chirata* Buch.-Ham. (1·7); *Datura metel* Linn. (30·5); *Digitalis purpurea* Linn (2·7), *Hyoscyamus niger* (11·4); *Hyoscyamus muticus* Linn. (8·6); *Andrographis paniculata* Nees (7·2); *Lobelia nicotianaefolia* Hyne (8·6), *Boerhaavia diffusa* Linn. (16·0); *Cassia acutifolia* Del. (35·0); *Cassia angustifolia* Vahl. (21·8), *Datura stramonium* Linn. (12·6), *Trianthema portulacastrum* Linn (10·0); *Adhatoda vasica* Nees (9·0).

The above data are mean of 100 determinations in each case.

29. Pharmacognostic studies on the leaves of Myrtus communis Linn.—the Indian Buchu of commerce.

S. C. DATTA, Calcutta.

The paper presents further detailed studies of the leaves of *Myrtus communis* Linn, which is sold in the Indian market under the name "Indian Buchu". This plant is considered as an adulterant of the true Buchu which is derived from *Barosma betulina* (Thunb.) Bartl. and Wendl. The infusion prepared from *Myrtus* is found to have different properties from the genuine Infusion Buchu, and the present work has been carried out with a view to bring out distinguishing characters of the leaves of *Myrtus* which could help the manufacturer to identify the crude drug at the time of purchase.

The macroscopical and miscropical features of the leaves as well as the characteristic histological elements in powdered leaves have been studied. Differentiating chemical tests for genuine and false Infusion Buchu have been evolved. Ultra-violet examination of the tincture from *Myrtus* shows a dark brown colour whereas the tincture from *Barosma* shows a greenish yellow fluorescence.

30. Pharmacognosy of the leaf of *Sida Carpinifolia* L.

S. N. BAL and DILIP GUPTA, Calcutta.

During the investigation on different species of *Sida* occurring in the lower gangetic plain of West Bengal, it was detected that *Sida carpinifolia* L. has got two distinct types which are of considerable pharmacognostic interest. These plants were grown under identical environmental conditions and the micrometric methods were applied to detect the identity from the leaves. The paper incorporates vein islet number, veinlet termination number, palisade ratio, stomatal number, epidermal cell number, stomatal index and trichome characters.

From these observations and also from morphological considerations it was evident that these two types are sufficiently distinct and it would be better to offer them some idependent rank in the taxonomy.

31. Characteristic distribution of Septate fibres in some Indian woods and their structures.

S. K. PURKAYASTHA, P. N. NIGAM and S. S GHOSH, Dehra Dun

The occurrence, distribution, and structure of septate fibre in dicotyledonous woods have recently attracted considerable attention to find out its role in the classification and identification of timbers. Generally the septate fibres occur intermixed with non-septate ones. But in timbers of some families, it occurs in paratracheal and apotracheal patterns simulating vertical parenchyma and thus causes considerable difficulty in the evaluation of anatomical characters for the purpose of identification in the field or timber yard. The timbers of four Indian genera having septate fibres in wide bands have been studied and the results are reported here.

In *Elaeodendron glaucum* Pers. and three species of *Gymnosporia* of the family *Celastraceae*, the length of septate fibres has been found to be considerably shorter than the non-septate ones. In shape and wall thickness, they also differ from the non-septate ones. The number of septa per fibre was found to vary from 1—5 in *Elaeodendron* and 1—3 in *Gymnosporia*. No definite relationship was found between the number of septa and the length of the septate fibres.

In *Allophyllus cobbe* Blume and *Paranephelium hystrix* Smith of *Sapindaceae*, the arrangement of fibres is interesting. The large and thin-walled septate fibres resembling parenchymo cells in cross section occurs in wide bands and alternate with similar bands of small and thick-walled septate fibres. These fibres also vary in shape and length, thin-walled fibres being shorter than the thicker-walled. In both these types the number of septa in a fibre varies from 1—5 but the longer ones appear to have more number of septa.

32. Amphivasal vascular bundles in *Cyperus*.

A P. MANI, Calcutta.

Basing on a detailed anatomical study of ten species of *cyperus* the following conclusions have been arrived at.

The presence of amphivasal bundles cannot be attributed to short internodes or fusion of foliar strands at the nodes.

The nature of the bundle, whether amphivasal or collateral is a specific character probably gene controlled.

Though amphivasal bundles are formed at various parts of the plant by fusion of collateral bundles or by the reorientation of their xylem elements, their longevity is dependent upon the nature of the bundles characteristic of that particular organ.

On the basis of evidence it is suggested that amphivasal bundles have been derived from collateral ones by the development of xylem elements all round the phloem in the evolutionary specialization of vasular bundles.

33. Morphology of Pollen grains of Indian plants.—I. Pollen Grains of some Local Plants.

S. D. CHITALEY, Nagpur.

This first paper in the series "Morphology of the Pollen grains of Indian Plants", deals with the description of thirty types of pollen grains collected from the plants growing in the vicinity of Nagpur. Seventeen dicot families are represented in this small collection. It is in commencement of building up a herbarium of pollen grains of Indian Plants. This is to meet the necessity of such a herbarium of tropical pollen flora for reference and guide in palynological investigations. In absence of any consolidated account of Indian Pollen Flora, any systematic and exhaustive identification of the Fossil Pollen in India is rendered very difficult if not impossible.

Terminology used in the description of pollen grains is after Erdtman. Technique used in preparation of pollen slides is a modified one after Wodehouse. Families represented in this paper are- Apocynaceae, Capparidaceae, Compositae, Convolvulaceae, Euphorbiaceae, Geraniaceae, Labiatae, Leguminosae, Lythraceae, Malpighiaceae, Malvaceae, Nyctaginaceae, Onagraceae, Portulacaceae, Rubiaceae, Scrophulariaceae, and Verbenaceae.

None of the pollen grains described here find any mention in the works of Erdtman and Wodehouse.

34. Pollen grain and pollen tube studies of Hibiscus in vitro.

P. SANYAL and B. C. KUNDU, Barrackpore.

During the course of interspecific hybridization at Jute Agricultural Research Institute, Barrackpore, the pollen grain and pollen tube studies in six different species of *Hibiscus* was undertaken *in vitro* to investigate how far such observations can be correlated to the data obtained from interspecific crosses.

The pollen grains in all the six species namely *H. cannabinus* L. ($2n=36$), *H. sabdariffa* L. ($2n=72$), *H. radiatus* Wild. ($2n=72$), *H. panduraeformis* Burm. ($2n=24$) *H. lunarifolius* Wild. ($2n=40$) and *H. vitifolius* L. ($2n=34+O—1B$) are round, yellow, covered with uniformly spaced spines with broad base and either pointed or sharply pointed apex. The average diameter of pollen grain is maximum in *H. radiatus* ($119{\cdot}12\mu$) and minimum in the case of *H. panduraeformis* (($91{\cdot}63\mu$). The maximum average length of the spine has been recorded in *H. vitifolius* ($20{\cdot}79\mu$) and the minimum in *H. panduraeformis* ($14{\cdot}50\mu$).

Germ pores are many in number, uniformly spaced and recognizable in some or masked by spines in other species. Polysiphonous condition of the pollen grains *in vitro* are reported in all the six species. Only one tube out of many is found to be viable, others contain only cytoplasm. In *H. vitifolius* a maximum number of 12 pollen tubes per grain has been observed which was closely followed by 8 tubes in *cannabinus* and *sabdariffa*. In the remaining species a maximum of 4 to 5 tubes are observed. Besides the polysiphonous condition, *H. cannabinus* and *H. vitifolius* also differ from the remaining four species by their branching conditions of the pollen tubes *in vitro*.

In view of the polysiphonous and branching conditions of pollen tubes, *H. cannabinus* and *H. vitifolius* have been considered to be more primitive than the remaining other species under study.

35. Structure and dehiscence of the anther in *Wormia, Dillenia* and *Ochna*.

C. S. VENKATESH, Delhi.

The structure of the anther in relation to its mode of dehiscence has been investigated in *Wormia burbidgei* Hk. f., *Dillenia suffruticosa* Martelli and *Ochna thomasiana* Engl. et Gilg. In *Wormia* and *Dillenia* stomia are confined only to the anther tip. They are broad and connect with the tips of the pollen sacs through intervening small celled resorption tissue. There is no fibrous hypodermis and only the epidermis persists in the ripe anther. However, cells of this layer possess fibrillar thickenings on their walls. At maturity, the stomia and underlying resorption tissue disorganise and the split ends of the anther wall curl inwards to form two large subapical pores through which pollen escapes. In *Ochna* the stomia are formed only in the upper part of the anther where the fibrous hypodermis is also well developed. In the lower part, the anther does not differentiate stomia and the fibrous hypodermis is obsolete. The anther therefore dehisces only for a short length and incomplete longitudinal slits are formed.

36. The floral morphology and embryology of *Tapinostemma Acaciæ* (Zucc.) Van Tiegh.

SUDHA GARG, Delhi.

The pentamerous flower is subtended by a single bract and the calyculus forms a conspicuous, slightly lobed rim. Each lobe of the corolla shows characteristic pennate outgrowths descending from the inner side of the adnate portion of the filaments.

The stylar canal is continuous with the central ovarian cavity at the base which arises an unlobed conical mamelon. The collenchymatous pad differentiates several layers below it.

The entire hypodermal tissue of the mamelon transforms into sporogenous cells. Linear tetrads are commonly formed and usually the lowest megaspore functions. The elongation of the gametophyte starts at the four-nucleate stage and the tips of five to seven embryo sacs (containing two nuclei) traverse the 35 mm. long style reaching as far as the stigma. A 6-nucleate condition (2+4) precedes the 8-nucleate stage. The egg apparatus and the upper polar nucleus are organised at the upper end. The tips of some of the embryo sacs may come to lie just-below the stigmatic papillae as in *Helixanthera* (Maheshwari & Johri, 1950).

The development of the endosperm, embryo and fruit is more or less similar to other members of the Loranthaceae.

Danser (1933) placed the genus *Tapinostemma* in the subtribe Hypheatinae. It resembles other members of this subtribe in possessing a 4 to 5-carpellary, one chambered gynoecium, and an embryo with fused cotyledons except in the region of the plumule. However, the unlobed conical mamelon has no parallel except in *Helicanthes elastica* which has already been assigned by Johri, Agrawal & Garg (1957) to a new subtribe Helicanthinae. In view of this similarity, it is suggested that *Tapinostemma* may also be transferred to the Helicanthinae.

37. A contribution to the embryology of Foeniculum and Coriandrum.

SHRISH C. GUPTA and KANTA KUMARI, Delhi.

To begin with, the flowers are normally hermaphrodite but due to occasional suppression of either the gynoecium or the androecium in *Foeniculum vulgare*, some of the flowers become unisexual. In *Coriandrum sativum* also, male flowers are formed due to suppression of the gynoecium.

The anther wall consists of the epidermis, endothecium, middle layer, and the glandular tapetum. The reduction divisions are simultaneous, cytokinesis takes place by furrowing, and tetrahedral and isobilateral tetrads are formed. The pollen grains are tricolpate and are shed at the three-celled stage. They may be ellipsoidal, rectangular or triangular. In *Foeniculum* chromosome bridges are observed during Meiosis I, and a high percentage ot pollen grains are nonviable.

Each locule of the ovary contains two ovules of which the upper degenerates early. The unitegmic, tenuinucellate ovule shows a multicelled hypodermal archesporium. One or two cells function directly as megaspore mother cells. The development of female gametophyte is of the Polygonum type. Sometimes, twin embryo sacs may develop in *Foeniculum*.

The endosperm is Nuclear, and the enucleated endosperm vesicles protrude into the central cavity. Centripetal wall formation is initiated after approximately 256 endosperm nuclei have been formed. The first division of the zygote is transverse (*Coriandrum*) and the embryogeny conforms to the Solanad type.

The viability of the seeds is very low which may be due to the abortion of the embryo or the endosperm. An insect often attacks the ovaries and lays eggs in them. These develop into adults at the cost of the embryo and the endosperm, thus causing embryolessness.

The fruit is a cremocarp with two mericarps. The pericarp is divisible into two zones—the outer mesophyllous and the inner parenchymatous. The seed coat is one-layered and is derived from the outer epidermis of the integument.

38. The embryology of *Mida salicifolia* A. Cunn.

S. P. BHATNAGAR, Delhi.

In *Mida salicifolia* (Santalaceae) the flowers are pentamerous, actinomorphic and bisexual. The ovary is semi-inferior and unilocular. The central placental column bears three hemianatropous ovules which do not show a clear demarcation into the integument and nucellus.

The embryo sac is monosporic and 8-nucleate. Usually three embryo sacs (one in each ovule) develop in an ovary. At the 4-nucleate stage, the tip of the gametophyte grows beyond the ovule and extends towards the stylar canal. A caecum arises from the chalazal end and enters the placental column, leaving behind the antipodal cells *in situ*.

The first division of the primary endosperm nucleus is followed by a wall resulting in the formation of a micropylar and a chalazal chamber. The latter functions as the primary endosperm haustorium. The nucleus of the micropylar chamber undergoes some free nuclear divisions before the walls are laid down. The nucleus of the primary endosperm haustorium probably cuts off a small cell. In this cell the divisions are accompanied by wall formation and three to four cells lying away from the first formed wall elongate considerably and function as secondary haustoria. They grow in the identity. From the endosperm cells of the micropylar chamber, particularly those adjacent to the chalazal chamber, arise numerous fingerlike processes which also act as absorbing organs. Endosperm formation may be initiated in all the three embryo sacs in an ovary but only one of these reaches maturity.

The first division of the zygote is transverse, and the mature embryo is typically dicotyledonous with a well developed suspensor.

The pericarp consists of three zones—the parenchymatous epicarp, stony mesocarp, and parenchymatous endocarp which is consumed by the endosperm. The seed is devoid of a seed-coat.

39. Embrylogical studies in *Costus speciouѕ* Smith.

M. G. PANCHAKSHARAPPA, Delhi

The anther wall consists of seven layers—the epidermis, endothecium, four middle layers and secretary tapetum. Due to periclinal divisions the tapetum becomes 2 to 3-layered. The pollen mother cells undergo successive reduction divisions, the tetrads are isobilateral, and the pollen grains are shed at the 2-celled stage.

The ovary is inferior, tricarpellary and syncarpous containing numerous ovules on an axile placenta. The ovules are anatropous, crassinucellate and bitegmic. The micropyle is formed by the inner integument which disorganizes during maturation of the seed.

The development of the embryo sac is of the Polygonum type. Rarely, twin embryo sacs may develop. The endosperm is Helobial and the chalazal chamber forms a 'basal apparatus'. A few layers of endosperm persist in the mature seed. The mature embryo has a lateral stem tip and terminal cotyledon. Secondary root primordia develop precociously.

The seed coat is stony and arises mainly from the outer integument. A caruncle develops at the free end of the outer integument. The characteristic 'micropylar collar' and a 'germinal lid' are also formed from the outer integument. At the time of germination of the seed, the germinal lid is pushed aside by the radicle.

40. The embryology of *Carex Wallichiana.*

C. K. SHAH, Delhi.

Carex wallichiana is a monoecious winter weed bearing uni- or bi-sexual spikes. The staminate spike is unbranched while the pistillate is compound consisting of a number of spikelets. Its apex invariably aborts so that the lateral female flower comes to occupy a terminal position. The entire female spike is enclosed by an ochreate glume known as the perigynium.

During meiosis II of the microspore mother cells, one of the spindles is tripolar, and due to failure of cytokinesis a tetra-nucleate mother cell is formed. Only one of the nuclei is functional and it becomes delimited from the other three by an ephemeral plasma membrane. The young microspores are richly cytoplasmic with a centrally situated nucleus. It divides to produce the vegetative cell and the generative cell. The three non-functional smaller nuclei may also divide but eventually all of them coalesce to form an irregular darkly stained mass. The 'pseudomonad' is shed at the three-celled stage.

The ovule is bitegminal, crassinucellar and anatropous, and has a placental obturator consisting of compact cells. The embryo sac is monosporic and 8-nucleate. The endosperm is Nuclear. When cell formation has taken place the peripheral part stores oil while the central abounds in starch grains and protein crystals. The embryo is typically monocotyledonous. In the germinating seed an elongated axis, the mesocotyl, is interpolated between the lamina and the cotylar sheath.

The seed coat is contributed by both the integuments. The testa remains separate from the pericarp. The latter consists of a starch-filled outer epidermis, 2 to 3 fibrous layers and the inner epidermis of thick-walled columnar cells.

41. Development of Ovule and Embryo Sac in *Croton Bonplandianum* Baill.

A. P. MANI, Calcutta

The ovule arises as a small protuberance from the upper angel of the placental axis and soon curves upwards to take up an anatropous form before the differentiation of the megaspore mother cell.

Ovules are crassinucellate and bitegmic with an early origin of the inner integument. The outer integument is initiated soon after the inner and covers it after a brief period of rapid growth.

The striking feature of the ovule is the presence of a very long tubular nucellus which reaches the central placental axis leaning over the obturator, the tip of the nucellus beak being swollen. The cells of the obturator are long narrow and loosly arranged.

The archesporium arises as a deep seated cell and directly functions as the megaspore mother cell. The megaspore mother cell by two divisions (meiotic) gives rise to a linear tetrad of megaspores of which the chalazal one develops into the ombryo sac and the other three degenerate. The megaspore next to the embryo sac degenerates earlier than the other two.

Development of the embryo sac follows the polygonum type The synergids are long and hook shaped.

42. Structure of the Flowers and the Development of Gametophytes in *Kyllingia triceps*, Rottb.

M. N GUPTA, Agra.

There is a single ovule which arises as a small protuberance in the base of the ovary. As it grows it bends away from the mother axis. At this time rudiments of the integuments are laid down and, by the time the megaspores have developed, the ovule becomes completely anatropous. The crassinucellate ovule is bitegmic with the inner integument only forming the micropyle. Both the integuments are two layered.

There is a single hypodermal archesporial cell which, by a periclinal division, forms a small outer primary parietal cell and a large inner megaspore mother cell. The primary parietal cell by further divisions developes a small parietal tissue and thus makes the megaspore mother cell deep seated. The megaspore mother cell elongates and by two reduction divisions gives rise to four megaspores which arrange themselves is a linear tetrad. Normally the chalazal megaspore is functional but occasionally the micropylar megaspore may also enlarge for some time simultaneously with the chalazal one. The three degenerating megaspores persist for a considerable time and may be seen in the form of caps at the micropylar end of the mature embryo sac. The development of the embryo sac confirms to the Polygonum type.

The young anther soon becomes four lobed and as seen in transverse section the archesporium is represented by a single hypodermal cell in each lobe. By a periclinal division the archesporial cell divides into a primary parietal cell and a primary sporogenous cell. The primary parietal cell by repeated periclinal and anticlinal divisions develops a wall which is three layers thick The endothesium is the outermost parietal layer. It develops fibrous thickenings and is the only parietal layer which persists at the maturity of the anther enveloped by a feebly lignified epidermis. Tapetum develops from the innermost parietal layer and is glandular and uninucleate throughout.

The primary sporogenous cells divide a few times and form the micro-spore mother cells. The microspore mother cells undergo two reduction divisions No quadripartition of the mother cell takes place and so the four resulting nuclei lie within the mother cell. One of the quartet nuclei, which remains in the centre of the mother cell, becomes the pollen nucleus while the remaining three migrate towards the innermost region in the mother cell where they degenerate without undergoing any division. Distinct septa develop between the functional and non-functional nuclei and also between the latter. Normally these septa disappear along with the degenerating nuclei but occasionally they persist even up to the formation of the generative cell. The generative cell when just formed lies in the narrow apical end of the pollen grain, but gradually it migrates towards the basal side and finally comes to lie in the outermost position in the pollen grain, which was previously occupied by the vegetative cell.

The pollen grains are normally bicelled at the time of shedding.

43. The Empryology of *Galium Asperifolium* Wall (=*Galium Mollugo* Linn.).

MOHD. FAROOQ, Aligarh.

The nucellar epidermis and the female archesporium are multi-cellular. The megaspores germinate by tube formation. Almost the entire embryo sac is organised in the micropylar canal. It is monosporic and 8 nucleate Sometimes five stamens may develop instead of four. The microspore tetrads are tetrahedral, decussate or isobilateral. The pollen is 3-nucleate at the shedding stage.

The endosperm is nuclear and the testa is two layered. The embryogeny follows the Sherardia variation of Solanad type The suspensor is long and haustorial in nature. It is uniseriate but some of its cells may undergo longitudinal division. The haustorial cells of the suspensor undergo transverse division and form filamentous structures.

44. Standardisation of the methods in quantitative microscopy—Part I. Change of Surface Area of Leaves due to Mounting Media.

B. GUPTA, Calcutta.

It was observed that, when fresh or dried leaves are variously treated for microscopic observations, the surface area of lamina changes according to the treatment and the mounting media. When fresh leaves were soaked for 20 hours or boiled in water-bath for ten minutes with those substances the following changes were noticed. The change of area was insignificant in physiological saline, distilled water, ethanol 95%, conc. Chloral hydrate solution; but significant changes occurred when Berlese mountant, Lactophenol, Glycerine 40% or Glycerine Jelly were used. If instead of using whole leaf, peeled epidermal layers were used, the changes of area were not significant.

When the leaves are dried and then boiled in water-bath for 10 mins.; about 20% shrinkage is noticed. Bleaching the dried leaves with chloral hydrate brought about significant shrinkage of the area. Similar shrinkage was observed in peeled epidermis after macerating the dried leaves with HNO_3.

The shrinkage is dependent on the nature of the veination of the particular region and spreading of the preparations require careful manipulation.

(f) Palaeobotany

45. Simarubaceoxylon Mahurzari Gen. et sp. Nov.— New fossil wood from the Deccan Intertrappean beds of Mahurzari.

L. J. SHALLOM, Nagpur.

A new fossil wood assigned to family Simarubaceae has been described in this paper for the first time from the Deccan Intertrappean beds of Mahurzari.

It is a medium coarse textured and distinctly diffuse porous wood, vessels small to medium size, evenly distributed, solitary or in radial rows of 2 's or 3 's, filled with tyloses, intervessel pits alternate and bordered, vessel ray and vessel parenchyma pits similar to intervessel pits. Parenchyma fairly abundant about the pores with lateral extensions present, diffuse parenchyma sparse. Rays broad to fine, the broad rays conspicuous, homogeneous made up only of procumbent cells, 2 to 7 cells in width and 1 to 70 cells in height, the uniseriate rays are short made up again of procumbent cells. Fibres non-libriform somewhat angular in cross section with fairly large lumen, non-septic and with bordered pits.

Comparisons of the fossil wood are drawn with families Rutaceae and Simarubaceae. It comes closer to family Simarubaceae and to genus *Ailanthus* in particular. The *Ailanthus* species studied were *A. excelsa* and *A. malabaricum* of which the later shows greater resemblance. Though comparisons of this fossil wood are drawn up with *Ailanthus* the name *Simarubaceoxylon* has been used in the sense that the fossil wood belongs to family Simarubaceae.

46. Effect of Chemicals on Fossil Spores.

SHIVDAYAL SAKSENA, Bhopal.

While working on the micro-spores obtained by the maceration of Carbonaceous shales from Ganjra nalla (23° 21′ : 81° 2′) locality in the South Rewa Gondwana basin, Central India, it was noted that the size of fossil spores alone cannot be taken as a criterion for the creation of new species. This conclusion was arrived at after making critical observations on the reaction of different chemicals on fossil spores. It was seen that different chemicals behave differently on the spores in changing their size. Some chemicals, such as ammonia and canada balsam tend to increase their size, while others, such as Alcohol and Zylol tend to decrease the size. Well marked results were obtained in case of fossil megaspores.

47. A new line in Palaeobotany—Medical Palaeobotany.

S. D. CHITALEY, Nagpur.

The present paper introduces a new line of investigation in Palaeobotany—Medical Palaeobotany. This is based on the author's observations of medicinal use of Plalnt-fossils and Fossiliferous rocks from the Deccan Intertrappean Beds of India.

Reference from Materia Medica by Madkarni, and from Indigenous Drugs by Chopra regarding the use of Fossil encrinite and clays like Fuller's Earth, led the author to start the present investigations for exploring therapeutic uses of Fossil-flora. An experimental clinic assisted by Doctors has been launched by the author for recording the results of oral intake of fossil-powders called **Fossiline.** Fossiline is prepared by pulverising Fossil-rock to 120-140 mesh and then sterilising it in an autoclave under 20-60 lbs. pressure. Fossiline is taken either with water or honey. Normal adult dose is about 10 grains of Fossiline 3 times a day. Frequency of dose varies with acuteness of complaint in direct proportion. Acuteness is relieved usually in 48 hours.

Over 400 cases have been recorded in the clinic within a year. The observations in the clinic reveal that Fossiline is definitely useful in the following diseases viz eczema, diarrhoea, dysentery, influenza, asthma, tuberculosis, hypertension, menstrual disorders and diabetis.

Whether Fossiline acts chemotactically, bio-tactically or neurotactically, or by either stimulating or inhibiting the inherant enzyme activity of the protoplasm or by affecting the electro-conductivity or the electro-magnetic potentials of the protoplasm of the cells of the human body has to be found out. For the present it can be said that it probably acts as a Cell-rehabilitator.

II. FLORISTICS

48. Some New Plant Records for Nagpur.

M. V. MIRASHI, Nagpur.

The paper draws attention to the neglect of systematic studies of the vegetation of Nagpur. As a preliminary step towards the compilation of an up-to-date flora for the place, the author records the occurrence of twenty five species in and round about Nagpur which have not been reported earlier in the published literature. The report is based on the personal findings of the author for the last six years.

The species described are spread over thirten families of the Dicotyledons and three families of the monocotyledonous angiosperms. They include some of the rare Indian plants like *Acanthospermum hispidum, Gomphrena celosioides, Alternanthera pungens* and *Hygrophila quadrivalvis.* Brief notes on the habit, habitat, frequency and abundance of the species have been added.

49. Studies on the Flora of Ravenshaw College Campus.

H. PATTNAIK and P. C. TRIPATHY, Cuttack.

Ravenshaw college campus is situated between 20° 48′ N. lat. and 85° 56′ E. long. This is 97′ above the sea-level and the soil is chiefly sandy loam in the open fields on the north and south, and at other places alluvial. The earth has been levelled except a few slopes towards the east and west. The climate is tropical.

Thirty seven families have been described from angiosperms besides a few gymnosperms. The habit of the plants varies and most of the trees and shrubs are cultivated. The herbaceous plants grow under natural conditions as weeds. Families like Compositae, Rubiaceae, Scrophulariaceae, Euphorbiaceae, Amarantaceae, Liliaceae, Cyperaceae, and Gramineae are dominant. In general, dicots are more dominant than monocots.

50. Studies on the Indian Flora (Eastern India): 4; Notes on the Flora of Simlipal Hills of Orissa.

ROLLA SESHAGIRI RAO and G. PANIGRAHI, Shillong.

A preliminary account on the vegetation, flora, soil and topography of the Simlipal hills comprising of a compact block of 1100 square miles and lying within 20° 30′ N. and 86°-86° 45′ E., is presented in this paper. It comprises of hills and valleys belonging largely to the Gondwana age and represents, in general, a primeval semi-evergreen forest with an extensive patch of dry deciduous type adjoining Similipalgarh and with several pockets of evergreen forest in deep moist valleys. The dominant species, *Shorea robusta* is associated with *Anogeissus latifolia, Terminalia tomentosa, Pterocarpus marsupium, Ougeinia oojeinensis* and others among the trees, *Cleistanthus collinus* and *Indigofera pulchella* species of *Randia* and *Gardenia* among the shrubs, and *Bauhinia vahlii, Mucuna prurita, Gnetum ula, Combretum decandrum* among the lianes and climbers over most of the area. Various species of Acanthaceae and Leguminosae form the ground layer in humid forest rich with epiphytic orchids and ferns whereas species of *Phoenix* and *Pteridium* and a few types of grasses almost cover up the open hill tops and exposed valleys in drier regions. *Salix tetrasperma, Homonoia riparia* and *Sizygium cumini* together with ferns like *Cyathea* and *Angiopteris* are common along the course of rivers.

In lower altitudes, however, sal is associated with *Diospyros melanoxylon, Terminalia arjuna, T. tomentosa, Madhuca indica, Schleichera oleosa, Butea monosperma* and *Woodfordia fruticosa,* the latter two species with their radiant glow of purple red flowers colour the countryside in this season.

As a result of survey over a period of twelve days in February 1958, 614 species were collected which include the following ten dominant families :—

Leguminosae (65 spp.), Orchidaceae (40 spp.), Gramineae (38 spp.), Compositae (31 spp.), Acanthaceae (24 spp.), Euphorbiaceae (22 spp.), Rubiaceae (19 spp.), Urticaceae (16 spp.), Aspidiaceae (14 spp.), and Pteridaceae (12 spp.).

51. Studies on the Indian Flora (Eastern India): 5; Vegetational notes on Southern Forests of Tripura State.

ROLLA SESHAGIRI RAO, Shillong.

Notes on vegetational studies made during the Botanical tour undertaken during August 1957 in the reserved forests of Cherilam, Radhakishorepur, Chandrapur and Garjee of southern parts of Tripura state lying between 23° 30′—24° N. and 90° 50′—91° E. are given in the paper.

The soil is mostly sandy mixed with clay. The hilly tracts most consist of sand stone. Climate is hot and humid with 31°C. and 91% as the average maximum temperature and humidity respectively, with frequent rains during the period of work.

The region under study with an elevation of 20-50 metres presents in general a typical moist deciduous forest. Mixed forests along Cherilam and Radhakishorepore consist mostly tree species of *Dillenia pentagyna, Careya arborea, Garuga pinnata, Terminalia belerica, Linnea grandis, Dalbergia procera* and others mixed with large shrubs of *Microcos, Grewia, Zizyphus,* and climbers of *Butea parviflora, Smilax zeylanica,* and species of *Dioscorea* and others. The ground cover is mostly composed of *Eupatorium, Desmodium, Flemingia, Commelina, Murdannia, Hdyotis* and several others.

Along the reserved forests of Chandrapur and Garjee, *Shorea robusta* forms the dominant component of the vegetation comprising tree species of *Dillenia, Ficus, Lagerstroemia* and others.

Among the collections, members of the families, Leguminosae, Gramineae, Orchidaceae, Commelinaceae, Rubiaceae, Tiliaceae, and Verbenaceae are well represented.

52. Studies on Indian Flora (Eastern India): 6; Observations on the Flora of Apatanang Valley and surroundings ranges, Subansiri Division, N.E.F.A.

ROLLA SESHAGIRI RAO, Shillong.

A preliminary account on the flora of the extensive Apatanang valley extending over 30 sq. miles and the surrounding mountain ranges with the range of altitude from 1500 m. to 2100 m. lying within 27° 30′—27° 36′ N. and 93° 47′—93° 53′ E. is presented in the paper.

The soil along the valley is partly alluvial and partly sandy. The mountain slopes are mainly rocks with a cover of clayey sand. The climate during November is comparatively drier with constant cold winds and with the average maximum and minimum temperatures as 20° C and 5° respectively.

As the valley is under intensive rice cultivation the herbaceous flora as weeds along cultivated fields and adjacent stagnant watery places consisting of *Cardamine trifoliolata, Viola patrinii, Hypericum japonicum, Impatiens longipes, Guizotia abyssynica, Dichrocephala latifolia, Torenia peduncularis, Dysophylla crassicaulis, Polygonum posumbu, Potamogeton javanicus, Coix lachrymajobi* and several others, is predominant.

Along the edges of the valley and villages' surroundings, *Pinnus wallichiana*, species of *Bambusa*, which are introduced species, are extensively cultivated. The vegetation on the mountain slopes is of temperate type comprising tree species of *Amoora wallichii, Alnus nepalensis, Syzygium tetragonum, Ilex theaefolia, Medinilla himalayana, Ficus hookeri* and several others which are occasionally covered by climbers such as *Hedera helix, Pentapanax leschenaultii, Crawfurdia campanulacea, Pratia montana*, parasites, *Macrosolen psilanthus, Taxillus vestitus* and by epiphytic orchids, *Bulbophyllum candidum, Liparis distans, Otochilus porrecta* and others. The middle layer consists of a few shrubby species of *Berberis wallichiana, Rubus birmanicus, Baliospermum corymbiferum, Litsea zeylanica, Callicarpa rubella, Viburnum coriaceum* mixed with tall herbs of *Cnicus involucratus* and small herbaceous species of *Sarcopyramis nepalensis, Valeriana hardwickii, Rhynchospermum verticillatum, Adenostemma viscosum, Primula elongata, Melissa parviflora, Erianthus fulvus, Gleichenia longistema* species of *Selaginella, Polypodium* and several others.

53. A Botanical tour to Pindari Glaciers and Kumaon Hill Stations.

T. ANANDA RAO, Dehra Dun.

During the months of September-October 1957, the writer surveyed the vegetation on the route to the famous Pindari Glaciers and around some of the Kumaon hill stations for the Northern Circle of the Botanical Survey of India with a view to prepare a comprehensive illustrated flora of the Kumaon Himalayas. The results of the exploration tour are described in the paper. The interesting collection includes species of certain endemic genera like *Clarkella, Nardostachys, Hemiphragma, Picrorhiza, Platystemma, Craniotome* and *Roylea*, four new records, viz., *Elatostema cuneata, E. ficoides, E. rupestre, Disporum pullum* var. *parviflorum*, a doubtful species of *Roscoea longifolia*, a rare fine specimen of *Balanophora involucrata*, two little known plants, viz., *Triplostegia glandulifera* and *Streptopus simplex* and a newly established small alpine herb *Parnassia kumaonica*. The total number of species collected in this tour is 760, of which 651 are Angiosperms, 6 are Gymnosperms and 40 are Pteridophytes. A few specimens of Bryophytes, fungi and algae were also collected.

54. The vegetation on the route to Milam Glaciers.

T. ANANDA RAO, Dehra Dun.

This paper describes in brief some of the observations made on the vegetation of the area during a visit to the Milam glaciers in June 1958.

The bridle path to the Milam glacier runs through valleys of Saryu, Ramaganga, Jakul and Goriganga and proceeds to Bogdwar situated at 3000 m. The roaring rivers are flanked on either side by mountains of considerable height. The valley and its environs support rich deciduous trees clothed with epiphytic ferns, orchids and lichens, whereas mountain slopes are chiefly dominated by mixed type of vegetation. The increase in elevation of the mountains is responsible for the occurrence of temperate plants. Above 2600 m. chir pine and banj oak is replaced by Tilonj (*Quercus diltata*), Karshu (*Quercus semicarpifolia*), chestnut and sycamore. At Bogdwar the mountain slopes exhibit thick forests of oak, pines, cedrus and Yew. Beyond the timber line the bugyals are formed up to the snow-line.

Beyond 300 m. the tree life becomes scanty and the shrubby vegetation dominates the ridges, spurs, gorges and canyons all along the path up to Milam glaciers. Many plants of sub-alpine belt are represented in this zone. The dwarf *Betula utilis* forests are found to exist in grooves sheltered by mountain gorges.

From Milam onwards to the glacial belt the whole area is a waste of glacier and snow crowned craggy peaks of gigantic heights. The vegetational types in this area are very distinct and they are distributed in the Goriganga valley, moraine zone and surrounding bugyals up to the snow-line.

The striking features of the moraine, lacostral and Bugyal vegetation are described in detail.

The interesting collection includes species of certain endemic genera like *Vicatia, Pentapanax, Hemiphragma* and *Picrorhiza* and a new record of *Corollorhiza* sp., a terrestrial orchid having jointed coralloid rhizome with sheathed elongated scape bearing small pale green flowers.

55. On a collection of plants from Lahul.

M. A. RAU, Dehra Dun.

During the summer of 1958, the author undertook a tour of the Chandra and Bhaga river valleys in Lahul beyond the Rohtang Pass (4500 m.) for the purpose of collecting plants for the Botanical Survey of India. This paper gives an account of the vegetation of the valley as observed by the author in the altitude range 3 to 4500 m. The valley is surrounded by high mountains and numerous glaciers and hill streams. The vegetation of the hill slopes alongside streams is rich but elsewhere there is general barrenness on account of the scanty rainfall. The most conspicuous plant alongside the streams is *Caltha palustris* with its bright yellow flowers. Trees are rare and on dry hill slopes are seen among others, ***Cousinia thomsonii, Eremurus himalaicus, Morina coulteriana*** and somewhat rarely, ***Meconopsis aculeata*** and ***Ephedra gerardiana***. Among the numerous temperate and alpine herbs collected in this tour, particular mention may be made of ***Isopyrum anemonoides*** and ***Oxygraphis polypetala*** of the Ranunculaceae, ***Lagotis glauca*** of the Selagineae and ***Triglochin palustre*** of the Scheuchzeriaceae.

The paper includes a preliminary list of the plants collected and is illustrated with fifty Kodachrome color slides.

56. Some plant records.

M. A. RAU and T. A. RAO, Delhra Dun.

This paper records new localities for the occurrence of the following species of Angiosperms: *Enhydra fluctuans* Lour (Rishikesh and Dehra Dun, U.P.); *Menyanthes trifoliata* Linn (Chamba, H.P.); *Alectra thomsonii* Hk. f. (Banda, U.P.); *Primula pulchra* Watt (Kashmir); *Corydalis duthiei* Maxim var *sikkimensis* Prain (Garhwal); *Elatostema cuneatum* Wt., *E. ficoides* Wedd., *E. rupestre* Wedd., *Roscoea longifolia* Baker., *Disporum pullum* Salisb. var *parviflorum* and *Corallorhiza* sp. (all from Kumaon, U.P.).

57. Studies on the flora of the Pakasura Hills (Hulical Drug R.F.) in the Nilgiri District, Madras State.

K. M. SEBASTINE, Coimbatore.

The Pakasura Hills remained so far botanically unexplored and four seasonal explorations were completed only during 1957-58.

The slopes of this mountain which reaches an altitude of 2097 M show zonations in their vegetation. Below 500 M the forest is of the Southern Tropical Thorn Type. Betwen 500 and 1167 M the forest shows resemblance to Tropical Secondary Dry Deciduous Forest. From 1133 to 1833 M occurs the Nilgiri Sub-Tropical Evergeen Type. The floristic composition of this region shows a mixture of species belonging to those of the Wet Tropical Evergreen Forest and the Temperate Forest. However, the former element usualy predominates. The trees in this area are comparatively smaller. From 1667 M upwards there is a gradual transition from Sub Tropical Evergreen Type till the Wet Temperate Forest is reached at the top.

It is noticed that some plants introduced into the Nilgiris have gradually got naturalised and run wild adding new elements to the floristic composition of this region.

The collections from this area include species of plants which are not recorded by Fyson and Gamble, for the Nilgiris though some of them are reported by the latter as occurring in the Western Ghats in a very general way.

58. A contribution to the flora of Alagar Hills, Karandamalais and surrounding regions in Madurai District, Madras State.

K. SUBRAMANYAM and A. N. HENRY, Coimbatore.

The Alagar Hills are situated to the north-east of Madurai and consist of a couple of ridges running north to south enclosing two fertile valleys. Closely associated with these hills are the "Natham Hills", the chief of which are the Karandamalais.

In Alagar and Natham Hills four seasonal explorations were made to the following places: Scrub jungle along the southern range of Alagar Hills, Nupuraganga, Peria-aruvi and Karandamalais.

The vegetation at the foot of these hills is of the scrub jungle type. Mixed deciduous forests occur at slightly higher levels and at still higher elevations, the evergreen and grass land formations are noticed.

The plants collected are enumerated in detail. Out of the plants listed the Leguminosae is very well represented with the largest number of genera and species; the next in order being Euphorbiaceae and Gramineae. The herbs and shrubs are better represented than the trees and climbers. During the four seasonal trips in these forests some species of plants were dominantly in full bloom in certain large areas of the forest. Phenological observations on these are recorded.

In the tanks, lakes and puddles around Alagar Hills and Karandamalais 49 Hydrophytes were collected. A detailed distribution of these aquatic plants in the various habitats is shown in a table.

59. The Flora of Kutch.

G. S. PURI, S. K. JAIN and MISS U. R. DESHPANDE, Poona.

The situation of Kutch on the western extremity of India makes it an interesting area for vegetational studies. The place is a meeting ground for variety of soils, climates and vegetation. The complete flora of Kutch has been worked out. The only early botanical works in the area are by Blatter and Thakar. Collections were made in different seasons. The flora has 93 families, 363 genera and 640 species. It includes all indigenous species reported from the area and those exotics which are now satisfactorily established. Ten dominant families are Leguminosae, Gramineae, Compositae, Malvaceae, Convolvulaceae, Euphorbiaceae, Cyperaceae, Acanthaceae, Amaranthaceae, Cucurbitaceae, Boraginaceae. The comparison with the neighbouring areas i.e. Sind on west, Saurashtra on south and Rajasthan on north-east has been shown.

The tree vegetation in the district is not rich and confines in the trap rock areas in the centre. The sandy and saline areas support very little tree vegetation. The common trees of the area are *Acacia arabica* Willd., *Acacia senegal* Willd., *Cordia rothii* R. & S., *Lannea coromandelica* Merr., *Salvadora persica* L., *Tamarix dioicia* Roxb., *Zizyphus mauritiana* Lamk , *Butea monosperma* O.K.

The scrub vegetation is the chief feature of the vegetation of Kutch. Several *Acacia* species grow as shrubs, other common shrubs being *Balanites aegyptica* Delile., *Commiphora mukul* Engl., *Calotropis gigantea* R. Br., *Capparis decidua* Pax., *Cassia auriculata* L., *Euphorbia neriifolia* L., *Euphorbia tirucalli* L., *Grewia tenax* Fiori., *Grewia villosa* Willd., *Indigofera* spp.

The climbers in the area are few such as *Cocculus hirsutus* Diels., *Cocculus pendulus* Diels., *Cissus quadrangularis* L., *Cardiospermum halicacabum* L., *Ipomoea pilosa* Sweet.

There is paucity of the aquatic plants because there are very few fresh water habitats. *Typha angustata* Bory. is the conspicuous plant in the marshy areas. Some parts of Kutch in south and south-west coast have mangrove vegetation. The trees among mangroves are *Rhizophora mucronata* Lamk., *Rhizophora candelaria* DC., *Bruguiera conjugata* Merr., *Agiceras corniculata* Blanco., *Avicennia officinalis* L., *Avicennia alba* L. The shrubs and prostrate herbs include *Salicornia brachiata* R., *Sueda nodiflora* Moq., *Sueda fruticosa* Forsk., *Haloxylon recurvum* Bange., *Salsola foetida* Del.

A few grasses such as *Halpyrum mucronatum* Stapf., *Aeluropus repens* Parl., *Heleochloa schoenoides* Host. also grow in and near the mangrove swamps.

Some epiphytic and ground parasitic plants also grow in the area such as *Orobanche aegyptiaca* Pers.. *Cistanche tubulosa* Wt., *Cuscuta reflexa* R., species of *Viscum* and *Dendrophthoe*.

The economic aspect of the vegetation of Kutch has been discussed. The flora has little forestry value as far as timber species are concerned. Several fibre yielding species grow in the area, such as species of *Corchorus*, *Leptadenia*, *Salmalia*, *Gossypium*, *Adansonia*, etc. The Banni grasslands of Kutch are the backbone of the cattle-wealth of Kutch. The common fodder grasses are *Ischaemum pilosum* Hack., *Apluda aristata* Linn., *Sorghum halepense* Per., *Bothriochloa pertusa* Stapf., *Bothriochloa glabra* Stapf., *Digitaria adscendens* Mesn., *Echinochloa colonum* Link., *Setaria lutescens* Hub., *Sporobolus indicus* R. Br., *Sporobolus orien-*

talis Kunth., *Eleusine indica* Gaertn., *Dactyloctenium scindicum* Boiss., *Dichanthium annulatum* Stapf., *Eremopogon foveolatum* Stapf., *Themeda triandra* Forsk., *Themeda cymbaria* Hack., *Cynodon dactylon* Pers., *Dactyloctenium aegyptium* Rich. A number of valuable medicinal plants grow in the area such as *Grewia tenax* Fiori., *Adhatoda vasica* Nees., *Asparagus racemosus* Willd., *Barleria prionitis* L., *Datura meter* L., *Helicteris isora* L., *Withania somnifera* Dunal., *Aloe barbadensis* Mill., *Bacopa monnieri* Pannel., *Cissampelos pariera* Linn., *Eclipta prostrata* L., *Evolvulus alsinoides* L., *Peganum harmala* L., *Psoralea corylifolia* L., *Phylla nodiflora* Green., *Solanum xanthocarpum* S. & W., *Tribulus terrestris* L., *Oxystelma esculentum* R. Br., *Cyperus rotundus* L., *Vernonia cinerea* Less.

Several other economic plants such as oil yielding plants, fruit trees, tanin plant also grow in the area.

The appendix includes an account of 640 species. Brief description of families and important field characters of all species are given. Exact localities of their occurrence have been given with authority for collection.

60. Flora of Rajasthan, West of the Aravallis.

G. S. PURI, S. K. JAIN, MISS N. N. KOTWAL, Poona and SHANTI SARUP,
Bharatpur.

Much of the arid zone of India is man made desert and its improvement can be effected through proper use of the existing vegetation and sufficient increase in the plant cover over the area. The first requisite of such a work is the complete knowledge of flora of the area. Full scale exploration and survey of the area was therefore done by us during all seasons.

The climate of the Indian desert has great extremes of temperature; the rainfall is very low, very irregular and uncertain.

The large number of cattle, goat, sheep, donkeys and camels in the area is one of the chief causes of the present desert condition of the area.

The only earlier botanical studies on some parts of the desert areas are by Blatter and Hallberg and Shanti Sarup and his colleagues. There is however, no complete flora of the area.

Rajasthan is divided by the Aravallis into two distinct climatic zones—west of Aravallis the desert area and east of Aravallis which is much more fertile and rocky. The total area under forest in Rajasthan is about 11% of the land area of which only 1% lies in the Western Rajasthan. The vegetation is xerophytic, excepting for some protected spots. *Prosopis spicigera*, *Acacia arabica* and *Acacia senegal* are the commonest tree species. The other tree species associated with these are *Acacia leucophloea*, *Salvadora oleoides*, *Belanites aegyptica*, *Tecomella undulata* and species of *Zizyphus*. The commonest shrubs are species of *Acacia*, *Capparis*, *Calotropis* and *Euphorbia*. The dry climate, sandy soil and heavy biotic interference renders the undershrub stage of vegetation as the most frequent vegetation cover of the area, e.g., *Calligonum polygonoides*, *Zizyphus nummularia*, *Crotalaria burhia*, *Leptadenia pyrotechnica*, *Capparis decidua*, *Indigofera argentea*, *Corchorus depressus*, *Commiphora mukul*, *Aerva javanica*, *Lycium barbarum*, *Fagonia cretica* and *Alhagi camelorum*.

The sandstone hills around Jodhpur and elsewhere have a fair amount of tree vegetation, common among which are *Anogeissus pendula*, *Gymnosporia spinosa*, *Euphorbia neriifolia*, *Acacia arabica* and *Grewia tenax*. A number of small shrubs also grow.

The common plants of the sandy plains around Jodhpur, Balotra and Barmer are *Capparis decidua*, *Crotalaria burhia*, *Aerva javanica* and *Leptadenia pyrotechnica*.

The commonest plants on sand dunes near Barmer, Phalodi and Bikaner are *Calligonum polygonoides*, *Panicum antidotale*, *Calotropis procera*, *Leptadenia pyro-*

technica, Indigofera argentea, Farsetia jacquemontii, Melanocenchris jacquemontii, Crotalaria burhia, Aerva sp., *Cenchrus ciliaris, Panicum turgidum, Rhynchosia arenaria, Eragrestis tremula* and *Cenchrus barbatus.*

The common trees and shrubs on gravelly soils are *Calotropis procera, Salvadora oleoides, Prosopis spicigera, Gymnosporia spinosa, Capparis decidua* and *Zizyphus nummularia.*

Limestone rocks and lime rich soils near Jaisalmer support good growth of *Grewia tenax, Barleria acanthoides, Pappophorum aucheri, Viola stocksii, Melanocenchris jacquemontii, Elyonurus royleanus, Tragus racemosus, Pegolottia senegalensis* and species of *Heliotropium* and *Convolvulus.*

The flora includes about 700 species of wild growing plants collected by us or reported from the area. Reference is also sometimes made to more important cultivated plants. Short descriptions of families and keys to genera and species are given along with short descriptions of the plants.

The flora is dominated by shrub species. Extremes of climate in general eliminate herbaceous plants and tree species. The shrubby plants show marked xerophytic adaptations such as long roots, spiny epidermal outgrowths, hairy coverings, reduction in transpiring surfaces and increased concentration of cell-sap. The stunted and prostrate trailing habit of the plants is a conspicuous feature.

A map showing the area of work, several figures showing rainfall, temperature and climographs and several photographs of important plants are given.

61. Flora of the Deccan Trap in Bombay State—I. Districts of Poona, Satara, Sholapur, Ahmadnagar and Thana.

G. S. PURI and S. K. JAIN, Poona.

The Deccan Trap country is formed of irregularly shaped sometimes isolated hills, extensive plateaux and plains. All areas in the districts of Poona, Satara, Sholapur, Ahmadnagar and Thana have been botanically explored during all seasons of the year. The main uniform habitat feature in the area is the presence of the Deccan Trap igneous rock formation which is distinguished into basalt, amygdaloid, ferruginous clay and ashy beds.

In areas with high rainfall and red and lateritic soil, evergreen vegetation is mainly present. In dense canopy forests grasses and herbs are fewer. Such vegetation was studied at Mahabaleshwar, Khandala and Bhimashanker. At Mahabaleshwar in plain areas with uneven surfaces *Syzygium—Memecylon—Acctinodaphne* community develops. Areas of poor shallow soil have *Randia dumetorum, Pavetta indica, Scutia myrtina* and *Zizyphus rugosa.*

The evergreen forests of Khandala are confined to deep, moist shady valleys and lower slopes. The forest at Meroli is very rich and comprises of several storeys of trees. Commonest trees are *Ficus nervosa, Ficus glomerata, Pongamia pinnata. Holoptelea integrifolia, Dysoxylum binectariferum, Alstonia scholaris, Mangifera indica, Schloichera oleosa, Syzygium cumini, Gmelina arborea, Erinocarpus nimmoni, Grewia tilaefolia,* etc.

The commonest shrubs of Khandala is *Carvia callosa, Carissa congesta, Canthium dicoccum,* etc.

Moist deciduous forests occur on the eastern side of the ghats, scatterred on the entire range of the Sahyadris, such as at Kolwan, Mulshi, Ambaude, etc. The commonest community here is *Terminalia—Syzygium. Tectona grandia*—is frequent, along with *Pongamia pinnata, Erythrina indica, Cordia myxa,* etc.

The shrub layer here has *Carissa congesta,* species of *Capparis, Acacia, Zizyphus, Lasiosiphon, Lantana* and *Woodfordia. Artemisia* and *Carvia* species grow in upper and lower parts of these hill slopes respectively.

Large forest areas of the Deccan Trap are covered with dry deciduous forests. These were studied at Katraj, Sinhagadh, Bawdhan, Ramling, Kasara, Vasind, Ahmadnagar, etc.

In the Thana district the predominant community is Teek-*Terminalia* growing on shallow soil on basalt and old alluvia. Trees of *Adina cordifolia, Bridolia retusa, Anogeissus latifolia, Butea monosperma, Schleichera cleosa, Lagerstroemia parviflora,* etc. are common. *Lannea coromandelica, Boswellia serrata, Diospyros montana* and *Dalbergia latifolia* are other common species of the dry deciduous forests.

Areas with heavy biotic influence are now covered with dry scrub forests. Shrubs or small trees of *Acacia arabica, Zizyphus xylopyrus, Zizyphus mauritiana, Capparis* sp., *Euphorbia nivulia, Gymnosporia* and *Flacourtia* are common species of these areas. *Lantana camara* and *Cassia auriculata* invade these areas in stages of further degradation.

Grasslands occur on the Deccan Trap in areas of forest clearings, or on flat plain areas on shallow hard soil or also on denuded hill tops and terraces of hill slopes in places of abandoned cultivation.

Grasses like *Dichanthium annulatum, Heteropogon contortus, Apluda aristata, Themeda quadrivalvis, Pseudanthistiria hispida* and *Ischaemum, Eragrostis, Aristida* and *Chrysopogon* sp. are more common.

The paper describes a flora of 1500 species. Short descriptions of families and species and keys to genera and species are given. The work is profusely illustrated by charts and photographs of vegetation and individual plants.

62. The Flora of North Kanara, Western Ghats, India.

G. S. PURI and R. K. ARORA, Poona.

The paper describes flora of the Humid tropics of north Kanara, a high rainfall area situated along the western ghats between 13°55′N and 15°31′N and 74°9′E and 75°10′E.

The district is mostly hilly with an area of 3910 sq. miles and with an annual rainfall of 260 cms. Geologically it consists of unclassified rocks, mainly granites, gneisses and laterites.

The district is fed by four main rivers, many streams and rivulets; and the alluvial soils of these bear good Teak and/or bamboo forests.

Four vegetation types viz. evergreen, deciduous, scrub and grasslands have been described for the district. Evergreen and semi-evergreen forests are met with in high rainfall areas while deciduous forests occur on alluvial soils. Scrubs are mainly biotic in origin, except for laterite scrub, which may be a bio-edaphic community. Grasslands have been formed in places in the forest areas as a result of biotic interference. The ecological status of some of the types is not clear yet.

Along the coastal belt on the west of the district mangrove forests are met with. The chief species are *Acanthus ilicifolius, Avicennia officinalis, Brugieria* spp., *Kandelia candel, Rhizophora micronata* and *Sonneratia casselaris.*

There are many ponds in the district which are rich in hydrophytic vegetation. Of these the common hydrophytes are *Nelumbo nucifera, Nymphaea* spp., *Urticularia* spp., *Ceratophyllum demersum, Hydrilla verticillata* and *Trapa bispinosa.* Other plants like *Blyxa, Pistigor, Limnanthemum, Lemna, Offelia alsinoides* are of less frequent occurrence.

On the waste places, abandoned fields and cultivated grounds, various plants come up. Some of these like *Ageratum conizoides, Ammannia baccifera, Blumes* spp., *Vernonia cinerea, Caesulia axillaris, Cressa cretica, Sphaeranthus indicus, Cassia auriculata, Cyathcoline purpurea, Desmodium triflorum* are quite common. *Ageratum conizoides* and *Mimosa pudica* are quite common along roadsides.

The district is rich in its medicinal wealth. Some of the plants like Strychnos nux-vomina, Capparis moonii, Terminalia chebula, Holarrhena antidysenterica, Rauwolfia serpentina, Centella asiatica, Grewia tiliaefolia and Helicteres isora are in great demand. Apart from this, important tree species which give the useful woods for plywood industry, match industry, Paper and Pencil industry etc. have been described.

The flora includes 1824 species belonging to 113 families with 1367 species of Dicotyledons and 22 families with 381 spp. of Monocotyledons, and with 75 spp. of cryptogams.

III. ECOLOGY

63. An experimental study of the dispersion and deposition of air-borne spores.

T. SREERAMULU and A. RAMALINGAM, Waltair.

The results of 12 experiments in which known quantities of *Lycopodium* spores (together with spores of *Podaxis* in some experiments) are liberated in the open air artificially from a point source and trapped on 'Vaseline' coated glass slides placed horizontally at 2·5, 5·0, 10·0, 15·0, 20·0, 25·0 and 30·0 metres from the source along 9 radii (20° apart in some experiments and 10° apart in others) under different meteorological conditions are given in full.

Comparing the data obtained for *Lycopodium* and *Podaxis* (from these experiments) with *Tilletia* and *Bovista* (from the data of Stepanov's Expts.) the effect of the size of the spore and the velocity of its fall on the dispersal distance is discussed and it is concluded that these have very little effect on the dispersal distance. It is also pointed out that the theoretical estimates of the 'maximum dispersal distances' (quoted as evidences for long distance dispersal of spores) do not hold good under conditions of normal turbulence of the atmosphere.

From the cross-wind data the relation of the lateral diffusion pattern to (*a*) the size of the spore (*b*) time of the day (*c*) prevailing wind speed (*d*) duration of spore liberation and such other factors is examined. The relation of the down-wind catches to the size of the spore and the time of the day is also discussed. From the data it is found that the diffusion pattern is mainly influenced by the atmospheric turbulence.

The experimental data are examined in the light of Schmidt's eddy diffusion theory : $\sigma^2 = 2\frac{A}{\rho}t$ and it is concluded that this theory is deficient in its description of the diffusion process because $\frac{A}{\rho}$ -- a supposed constant in the equation—is found to vary widely with the wind speed and also because 'σ^2' varies approximately as 't^2' and not as 't' as predicted by the theory.

The result of these experiments when examined in the light of Sutton's theory of eddy diffusion : $\sigma^2 - \frac{1}{2}C^2X^m$ are found to be in closer agreement. The values of the parameter 'm' in the equation are in excellent agreement with those given by him. The values of the other parameter 'C' are found to be variable (varying from 0·32 to 0·74$^{m^{1/8}}$). Various factors which may bring about this variation are discussed and it is concluded that 'C' (obtained in this study) depicts the general coefficient of diffusion in all directions and the need for undertaking a simultaneous study of horizontal and vertical diffusion from which separate coefficients : 'C_y' and 'C_z' along the two axes : 'y' and 'z' by further experimentation to throw more light on this aspect is emphasised. The value of 'p'—the deposition coefficient—is calculated and it is found to vary with the distance from the source, the prevailing wind speed and the time of the day. The results of experiments conducted during day time are compared with the results of experiments conducted by Stepanov in Russia in 1933 and those of Gregory, Longhurst and Sreeramulu in England in 1956 and are shown to be in fair agreement. The small range of values for 'm', the existence of a continuous variation in the value of 'C' and a reasonably good agreement in the value of 'p' with the theoretical values are taken as evidences to conclude that the dispersion and deposition formulae given by Gregory in 1945 (based on Sutton's theory of eddy diffusion proposed in 1932) explain the process of spore transport in air over short distances of travel.

The significance of these results in evolving control measures for airborne fungus diseases is discussed and it is suggested that while paying attention to isolation most emphasis should be placed on eliminating foci of disease within a crop.

64. Sal (Shorea robusta Gaertn.) seeds and their germination.

N. K. JAIN, Jabalpur.

Sal bears monocarpellary single seeded winged fruits. Fruit wall and seed coat are very thin. Size, weight and volume of seeds and its output have been determined.

The seeds which are viable for a period of about 3 weeks are attacked by mould. Upon putting them for germination, only those seeds successfully germinated which have less of fungal attack. A number of treatments given to the seeds reveal that mechanical treatment appears to favour the percentage germination slightly. In continuous light the seeds fail to germinate. However, with the alternate period of light and dark (12 hrs. light and 12 hrs. dark, 18 hrs. light, and 18 hrs. dark) appear to favour percentage germination. Lower temperature and alternate low and high temperature of 24 hrs. duration each have retarding effect, on percentage germination. At room temperature (June) and a temperature little higher germination appears to be accelerated. Seed coat and the fruit wall appeared to be quite permeable to water and it is noted that after bathing the seeds in conc. sulphuric acid the embryo appears to be affected and the seeds do not germinate. Seeds appear to be quite tender and an electric shock of 250 volts is harmful to it Seeds treated with copper sulphate show less fungal attack and medium percentage of germination have been observed. Indole acetic acid has marked accelerating effect in the germination experiment and the highest percentage of germination, i.e. 62·5 has been observed by this treatment.

65. Growth behaviour of Sal (Shorea robusta Gaertn.) in different culture experiments.

N. K. JAIN, Jabalpur.

The study deals with the growth behaviour of Sal saplings grown in garden soil in the laboratory under the varying conditions of daily watering, weekly watering and water logging. The differences in the growth behaviour of saplings grown in garden, basalt, alluvium, laterite, sand, and sandstone soils along with the lime dressed and acid watered garden soils have also been observed. Sand culture experiments were performed to know the necessary chemical elements required by Sal saplings. Texture of the soils used in the culture experiments were determined. Soils were chemically analysed for pH, exchangeable calcium, iron, magnesium, phosphate, organic carbon and total nitrogen, before transplanting the saplings and after six months of successful Sal growth on them.

It is concluded from the observations that Sal grows best in daily watered garden loam. Saplings could not survive in water logged conditions. Among the different types of soils used, garden soil was the best for the luxurious growth of Sal,

Sal saplings kept in lime dressed and acid watered garden soil could not survive more than a few weeks.

Chemical analysis of the soil has revealed that the saplings grow best in a pH near neutral, with medium amount of calcium, good organic carbon and nitrogen and in a sandy-loam type of soil. It has less growth under the reverse conditions. Acidic garden soil having pH 4·34 is also harmful to the plant. Sand culture experiments have shown that Sal saplings growing in sand devoid of magnesium or phosphate die in a very short period. In calcium or iron deficient media, saplings gradually became leafless. Sal saplings supplied with calcium, magnesium phosphate, iron, chlorine and sulphate ions without sodium have most luxurious growth.

66. Root ecology of Dichanthium annulatum Stapf.

S. S. RAMAM, Varanasi.

Dichanthium annulatum Stapf. is a tufted deep rooted perennial grass on heavy textured pale brown soils growing either in pure stands or mixed with populations of species of *Setaria, Cynodon,* and *Bothriochloa.* Single seminal root emerges out on seed germination which branches quite freely and persists upto 35 days from the date of emergence. Nodal roots are uniform penetrating vertically down upto 80 cm. Root surface area permeating the soil mass is quite high. Soil binding capacity for the roots of *Dichanthium* is directly proportional to the quantity of root growth. Concentration of roots is found in the upper 10 cm. of the soil horizon. Nitrogen content is quite low down the rooting zone. Soil reaction fluctuates from neutral point to slightly alkaline range throughout the horizon. Water soluble salts concentrate near the soil surface. Soil nutrients like Calcium, Magnesium, Potassium and Sodium are quite uniform down the rooting medium. But Calcium and Potassium form the major part of cation adsorption complex of soil mass permeated by the roots. Soil data confirm the preference of *Dichanthium annulatum Stapf.* for heavy textured fertile alluvial soils rich in Calcium and Potassium in the exchange complex of the soil mass.

67. Effect of cement bed on the root habit of Rumex dentatus L.

R. S. AMBASHT, Varanasi.

Root habit of *Rumex dentatus* L. has been studied in normal habitat and in 16·5 cm. deep soil overlying a cement bed. In normal habitat the root depth is smaller than or at times equal to the shoot height, but in the habitats with the hard pan the roots grow laterally to four or five times the length of a normal plant. Normally roots of *Rumex* are about 8 to 20 cm. long and not very much branched, but in a 26 cm. tall plant growing in the soil on cement they were 16 5 cm. deep but with lateral extension of 85 cm. with fine rootlets in high moisture region. Similarly a 10 cm. tall plant of *Rumex* had 16·5 cm. deep root with 47 cm. of lateral spread. The reason for the different root habits has been explained on the basis of capillary movement of soil solution and the availability of nutrients.

68. Root habit of some plants on two alluvial soils.

R. S. AMBASII, Varanasi.

Root system of some plants on new and old alluvium at Varanasi has been described. Ganga river bank due to periodic inundation from floods reveives deposition of new soil. Rajghat plateau is at a higher level and escapes inundation. The former, therefore, consists of new and the latter of old alluvium.

Soil profile study of new alluvium shows clear layers of successive depositions which consist mainly of fine sand (70—90%). Root system of *Solanum xanthocarpum, Chrozophora rottlari* and *Alhagi camelorum* have been described. Higher relative humidity during rainy season is suggested to be responsible for the death of serial parts of *Alhagi.* On the vertical cuts *Euphorbia hirta* develop roots on one side in a plane at right angles to the axis of the shoot. Mention has also been made of roots of *Cleome viscosa, Phyllanthus niruri, Leucas aspera* and *Xanthium strumarium.*

Rajghat plateau is exposed to severe monsoon erosion and this exposes the roots of plants growing thereon. The root systems of such plants have been described as are capable of regenerating shoots on exposure. *Pongamia pinnata, Tamarindus indica, Aegle marmelos, Capparis sepiaria, Diospyros cordifolia* and *Millingtonia hortensia* show such root habit. *Kikxia vamosissima,* a perennial herb which grows only on very steep slopes in the ravines has the tendency of one sided root development like *Euphorbia hirta.* Exposed roots of *Kickxia* also develop shoots.

69. Root systems of two species in different soil types of Jabalpur.

S. C. PANDEYA and S. N. AWASTHI, Jabalpur.

The paper deals with the study of the root systems of *Acanthospermum hispidum* D.C. and *Tephrosia purpurea* Pers., as they occur in different types of soil at Jabalpur. Further, an attempt has been made to correlate the soil physical characters with the root systems. The study has been made on : calcareous clays, sandstone soils, alluvium, basalt black soils, laterite type and granitic soils.

The study reveals that :

Tephrosia purpurea has maximum root length in granitic soils, being 62·4″ The minimum length is in Narmada river alluvium. In granite soils moisture is kept low and increases with depth. *Acanthospermum hispidum* has longest roots in laterite type of soils, and smallest in calcareous clays.

Thus the form of rooting system of a species depends largely upon prevailing edaphic conditions, such as water content, pore space and texture of the soil.

70. Soils of Jabalpur.

S. C. PANDEYA and M. D. DUBEY, Jabalpur.

An investigation of the profiles in the soils on different geological formations of Jabalpur has been made and the study reveals :—

1. All the profiles are immature. They are different in chemical characters.
2. Sandstones, laterite and granite soils have low percentage of exchangeable calcium and higher percentage of exchangeable sesquioxides. Their pH is neutral to acidic. Basalt residual soils contain medium amounts of exchangeable calcium and sesquioxide. They are basic in nature. The transported or alluvial soils are basic, with high percentage of exchangeable calcium and low percentage of sesquioxides. Calcareous clayey soils are calcium carbonate soils and have medium amount of exchangeable calcium, low organic carbon and low exchangeable sesquioxides. In such soils, calcium probably is not a toxic element, since it is available to plants only in small doses.
3. It appears more appropriate to study the soil complex of a region under the following 3 groups :—
    - (i) Skeleton or immature soils—soil under formation.
    - (ii) Leached-down soils—mature.
    - (iii) Post leached-down soils.

71. Distribution of Peristrophe bicalyculata Nees. in Relation to Soil Nitrogen and Light.

R. MISRA and P. S. RAMAKRISHNAN, Varanasi.

Peristrophe bicalyculata Nees. is found to grow in nitrogen poor soil in the open and nitrogen rich soil in the shade. Germination and culture experiments were set up to find out the interaction of light and soil nitrogen in assimilation and growth. The natural distribution of the plant in nitrogen poor soil in the open is explained primarily on account of favourable germination and subsequent normal growth. Both germination and growth are found poorer with increasing doses of soil nitrogen and the plant assimilates it less and less. On the other hand, increased doses of nitrogen in partial shade which is the most suitable habitat, promotes percentage germination, growth and nitrogen assimilation. The last becomes very high in deep shade which somehow results in poor growth.

72. Effects of different soil types on the growth rate of *Anogeissus Latifolia* Wall.

S. R. JOSHI, Jabalpur.

From a detailed study of phytosociology of the three types of forests of Madhya Pradesh, soil analysis and foliar analysis of *Anogeissus latifolia* it has been noted by the author (1958) that the species which has been mentioned to belong to miscellaneous type of forests (Misra, 1956) grows best in these forests having less biotic operations.

Young saplings with a few leaves and produced by the germination of seeds were transplanted to pots containing different types of soils, e.g., garden loam, basaltic soil, alluvium, laterite, sand, sandstones and calcium dressed soil. Different water conditions like daily watering, weekly watering and water logging were tried to garden soil. Weekly growth of the plants were noted. This consisted of height, number of leaves and length of leaves.

It has been observed that *Anogeissus latifolia* grows best in loose soil (like garden loam), however sandy soils with low pH and very less amount of calcium appear detrimental for growth. But too much of calcium and water logging have proved harmful to the plant. The plant shows best growth in the month of March when a large number of leaves come out and with it the old leaves start gradually falling down.

73. Seasonal variation in the foliar contents of *Anogeissus Latifolia* Wall.

S. R. JOSHI, Jabalpur.

The present study was undertaken to find out the seasonal variation in the foliar content of *Anogeissus latifolia* and also to see if there is any relation between these variations in the foliar content and the phenological behaviour of the species.

Anogeissus latifolia is a wide-spread tree species and occurs in all parts of India except Assam and Bengal (Troup, 1921). It has been described to shed the leaves by February—March and thus remains leafless during summer. But at Jabalpur the author has observed that the tree never becomes leafless. The new leaves come up even when old leaves are there. Thus it can be called as a semi-deciduous species. It starts flowering some times in September. The seeds mature by December in Madhya Pradesh.

Collection of assorted leaves of one tree about 15′ high was started from January.

The leaves were analysed by usual methods for ash, silica, calcium, iron, nitrogen, magnesium and phosphorus.

It has been observed that ash, silica, calcium, magnesium and phosphorus tend to increase with the age of leaves. But nitrogen and iron probably decrease with the age. Exact reasons for this have not been assigned.

74. Studies on the Physiological Anatomy of a few Hydrophytes of Cuttack.

P. C. TRIPATHY, Cuttack.

The Physiological Anatomy of a few hydrophytes like *Trapa bispinosa*, Roxb., *Nymphaea rubra*. Roxb., *Ipomoea replans*. Poir., *Eichornia crassipes*. Solms., *Corchorus capsularis*. Lamk., and *Ludwigia parviflora*. Roxb. occurring in and around Cuttack was studied. In the immersed forms like *Trapa* and *Nymphaea* there was profuse development of aerenchyma; in the floating forms like *Ipomoea* and *Eichornia* there was a large hollow pith; in *Ludwigia* the loose cortex and air spaces in the pith, and in *Corchorus* the large hollow pith are of special significance in the interest of hydrophytic adaptations of terrestrial forms. The vascular bundles are very poorly developed in *Trapa*, *Nymphaea*, and *Eichornia*. In *Ipomoea* xylem bundles are very loose; in *Ludwigia* the xylem trachieds appear to be dissolved and give rise to lacunae at several places, whereas in *Corchorus* the supporting elements like pericycle are feebly developed. On comparison with the terrestrial species of *Corchorus*, *Ludwigia*, and *Ipomoea* the aquatic species show a distinct hydrophytic adaptation in having reduction of protecting structures, development of air passages, and reduction of supporting and conducting elements.

75. Distribution of Lac-bearing trees in Purulia Revenue Thana.

B. B. DAS, Purulia.

West Bengal, after reorganisation of states, occupies an important position in the production of lac in India. The new district of Purulia which has been transferred to West Bengal produces nearly 2,000,000 mds. of lac annually which is about one fifth of the total lac produced in India.

The area under review is Purulia Revenue Thana. It occupies an area of 772·22 sq. miles which is about one third of the total area occupied by Purulia district. It is situated approximately between latitudes 23° 10′ N and 23° 30′ N and longitudes 86° 15′ E and 86° 45′ E. The altitude of the area is approximately 750′ above sea level.

The soil is poor. It is generally red in colour and mixed with gravel (Kankar). The soil pH varies from 4·5 to 7·5.

The annual rainfall is just over 50 inches and the temperature varies between 13°C to 42°C.

In open forests Palas (*Butea frondosa*), Khair (*Acacia catechu*) Kul (*Zizyphus jujuba*) occur in patches in most parts except in hills where Kusum (*Schleihea trijuga*) take the place either singly or in groups. The host plants in W. B. are mainly planted on fields and homestead lands.

Concentration of Palas is more in clayey soil but *Khair* monopolises the eroded areas. Production of lac by utilising these idle host plants is of paramount importance in the national economy. *Khair* and occasional Berkul occur only in such areas where Palas predominates.

Lac occupies an important place in the economy of West Bengal almost similar to that of jute. Following the reorganisation of states some of the lac producing areas of Bihar have been transferred to West Bengal, resulting in the increase of production of the commodity from 45,000 mds. to 2,45,000 mds.

76. Role of the Desert Weeds in the Immobilization of the Indian Desert.

B. M. SHARMA, Bhilwara.

The ecological studies on weeds have so far been only cursory. The present study mainly deals with the Desert Weeds. It might serve a useful purpose not only from the purely scientific and ecological point of view but also utilitarian purposes. The study was undertaken at Jodhpur which is an important town on the fringe of the desert. The factors affecting the weed growth in the area have been discussed in detail. The results of soil analysis show that the main disturbing factors in the soil are its sandy nature and the low water content. Otherwise the soil contains other mineral nutrients necessary for the growth and development of the vegetation in general.

Root system of the weeds was carefully studied. It shows that there are three main types viz.; the deep root system; small surface root system; and the shallow root system with considerable lateral spread. Morphology and histology of the weeds was studied with a view to find out their adaptations to the environment. It was found that the weeds have adapted themselves to the prevailing conditions by the development of the xerophytic features. Floristic composition is given along with a list of weeds found in the area. The mode of succession had been indicated.

How the weeds act in the immobilization of the spreading desert, has been mentioned. A few weeds like *Tephrosia purpurea*, *Aerua tomentosa*, *Boerhaavia diffusa*, *Tribulus terrestris*, *Trianthema monogyma*, *Gynandropsis pentaphylla*, have been suggested which may prove very effective in holding the moving soil and resist erosion. They may thus aid in the afforestation of the desert area. Some of these weeds like *Tephrosia purpurea*, *Gynandropsis pentaphylla*, etc. have recently invaded the region and are advancing along the roads or other distribution channels and help in checking the soil erosion.

77. Biotic factors and the Sal (Shorea robusta) Forests of U.P.

HARISH P. BHATNAGAR, Dehra Dun.

Biotic factors are amongst the many causes of the failure of natural regeneration of sal in the forests of Uttar Pradesh. The damage done to the forests by forest biota sometimes is quite severe. Activities of men, however, are most destructive. Grazing by domestic animals can altogether change the forest vegetation. Wild animals and insects come next to man. Browsing mammals are at certain places the cause of total failure of natural regeneration of *Shorea robusta*. Defoliating insects are also quite destructive specially after forest fires. Climbing and parasitic plants and fungal pests of *Shorea robusta* are also active and they do some damage to the trees. *Polyporus shorea* is by far the most destructive. Besides damage, the forest biota are also concerned in doing some good to the forests. Earthworms and many other soil dwellers make soil fertile and porus. Pigs form natural seed beds by digging. Fire also aids to further natural regeneration by reducing floor vegetation.

78. Succession in some Shorea robusta Forests of U.P.

HARISH P. BHATNAGAR, Dehra Dun.

Succession studies in the dry and moist *Shorea robusta* types indicate that there is evidence for the two main lines of successional change namely progression and retrogression. The dry *Shorea robusta* types (A1 & A2) ultimately degrade into a grassy savannah of dry type passing through the mixed miscellaneous stages. The primary succession in the dry type starts from grassland association with species like *Saccharum spontaneum, Erianthus munja* etc. which leads to the mixed miscellaneous stage. This may retrogate to deciduous forest or to mixed forest with *Shorea robusta* and finally to a dry savannah.

In the moist *Shorea robusta* type the primary succession starts from grasses and leads to mixed forests of *Shorea robusta* with *Terminalia tomentosa, Syzygium cumini* etc., after passing through mixed miscellaneous seral stages. This moist *Shorea robusta* may degrade to dry *Shorea robusta* type than to mixed miscellaneous forests and ultimately to dry savannah. In localities with higher water table and under moisture conditions, retrogression may proceed towards savannah with tall grasses. The tall grass savannah may be more or less stabilised as a sort of post climax association.

79. Vegetation types of the Upper Lachung Valley in Northern Sikkim.

K. C. BASU CHAUDHARY and S. SINHA, Agra

During October 1957, a botanical expedition was organised to the Upper Lachung Valley in Northern Sikkim to study the vegetational types and this paper is a result of the observations and collections made on that occasion. Sikkim has been visited earlier by several botanists who have made very important contribution to the flora of some parts of the State. Hooker's historical exploration in several parts of Sikkim and Smith and Cave's expedition in the Lohnak and Zemmu valleys have yielded comprehensive data about the knowledge of the flora there. Shebbeare (1931) has also given an account of the conifers of Sikkim.

Observations of the present study indicate 7 distinct formations between 8,000 and 18,500 ft. in the Lachung Valley. The following formations were recognised in ascending series :—

1. *Quercus-Tsuga* Formation.
2. *Quercus-Abies* Formation.
3. *Rhododendron-Alnus* Formation.
4. *Rhododendron-Juniperus recurva* Scrub
5. Pure *Abies* Formation.
6. *Rhododendron*-Dwarf Maple Formation.
7. *Rhododendron* Scrub.

80. A preliminary survey of the vegetation of Bijnor (U.P.)

Y. K. SARIN, Dehra Dun.

During the month of March 1958, some parts of the Bijnor District were visited for a collection of plants for the Botanical Survey of India. A preliminary account is presented in this paper.

The south-eastern portions of the district constitute a part of rich forest belt stretching from Hardwar to the borders of Naini Tal. The vegetation is somewhat similar to that found in the foot hills of outer Himalayas and Siwalik ranges. The majority of tall trees in these forests are of deciduous type while those of smaller heights are evergreen. The shrubs form a distinct association in the partially cleared forest belt.

The plains between south-eastern forests and the river Ganges abound in open scrub forests, jheels and numerous streams and rivulets. The vegetation here is predominantly of open scrub forest type, represented chiefly by *Butea monosperma*—*Salmalia malabarica* association. The woody sciophytic vegetation is represented by *Glycosmis pentaphylla-Adhatoda vasica* association almost to the exclusion of other herbs, while on open sandy areas *Croton bonplandianum, Zizyphus nummularia, Solanum xanthocarpum* and tall *Phoenix sylvestris* are more frequently seen. The banks of Ganges and other rivers show a rich growth of psammophytic annual and perennial herbs. The hydroseral communities in stagnant water ponds locally called 'Jheels' are well represented in distinct zones, being chiefly composed of *Hydrilla verticillata, Potamogeton indicum, P. crispus, Utricularia fleuxsa, Ceratophyllum demursum, Limnanthemum cristatum, Hygrorhiza aristata, Trapa natans,* and species of *Eichhornia* and *Nymphaea*. The preliminary list of the species collected during the above survey is given in the systematic census.

81. A reflection on Aquatic Flora in Sambalpur.

C. R. MOHANTY, Sambalpur.

The Geographic situation of Sambalpur is 21° 30′ North & 84° 3′ East. Topographic Zonation of the place strikingly characterises and closely associates with the varied split of aquatic flora. To the east, the aqueducts and the aquatic patches abound in plants rooted to the bottom and floating leaves emerge in the surface of water as the height of water deepens. Examples furnished by species of *Nymphaea, Nelumbium, Potamogeton, Lemna, Utricularia* even in canals taking origin from water-stock in Hirakud. Conspicuous growth of *Cladophora,* filamentous forms (Ulothrix and Spirogyra) is marked.

The rapidity in flow of water-stream in canals reveals the vascular strand demarcating plainly the relation between the aquatic form and its environment.

Soil particles are usually carried in water-current depending much upon the rate of flow. The particles are deposited as the continuity of flow is checked. The organic and inorganic content of the silt too often differentiates the growth of aquatic forms. With the precipitated soil enriched with organic substances and Iodine *Sagittaria* grows rampant.

82. Studies on the vegetation of the Dangs District in Bombay.

S. K. JAIN, Poona.

The Dangs district is situated between Lat. 20° 30′ N & 21° N and Long. 73° 15′ E and 74° E. The whole district is mountainous with an irregular configuration; the dominant features of scenery being hills, plateaux and valleys. In the eastern part mountains are up to 1,000 meters in altitude, which gradually merge with the plains of Gujerat on the western coast. The underlying rock are basalt and amygdaloid, giving rise to red, brown or blackish soils. The area is botanically unexplored. A number of collection tours have been undertaken in various seasons and floristics have been studied along transects in quadrats. The vegetation is generally dry deciduous, however, in protected moist spots evergreen species also occur, and the forests tend to become moist deciduous. Teak-*Terminalia* is the dominant community with associated species of *Anogeissus latifolia, Lagerstroemia* sp. *Ougeinia oogeinensis* Hoch., *Lannea coromandelica* Morr., *Dalbergia latifolia* Rox., *Acacia chundra* W., *Garuga pinnata* Roxb., and *Adina cordifolia* Bth. & Hk. f. *Wrightia tinctoria* Br. and *Helicteres isora* L. are commonest second storey plants.

According to habitat features the vegetation is divisible into following types—

(1) Hill slopes Teak-*Terminalia* community.

(2) Hill tops—*Terminalia crenulata* is the dominant type.

(3) Moist situations and lower hillslopes—*Bambusa bambos* type.

(4) Upper hillslopes and drier plateaux—Miscellaneous species dominate here mixed with those of the first and second type.

(5) Riverain type—*Syzygium cuminii-Pongamia pinnata* community.

(6) Grasslands—Forest clearings or plateau tops have small patches of grasslands.

The ecological status and succession in these types are being worked out.

The vegetation has been studied at Waghai, Raiwad, Susarda, Chikalda, Billaya Hill, Dungarda, Dhavlidhar, Ahwa, Gugli, Mulchund, Pimpri, Chadvi, Mahal, Chankhel, Lavchuli, Subir, Piplemar, Kotbha, Shivbara, Dholeambar, Chikarmati bari, etc.

Several matchwood species grow in the district, viz., *Salmalia malabarica* Sch. & Endl., *Lannea coromandelica* Merr., *Garuga pinnata* Roxb., *Kydia calycina* Roxb., *Holoptelia integrifolia* Planch., *Grewia nodiflora* L., and *Spondias mangifera* Will.

Bamboos Dendrocalamus strictus Nees., and *Bambusa bambos* Voss. are abundant and are exploited.

Several valuable medicinal plants grow in the district such as *Helicteres isora* Linn., *Eclipta prostrata* Linn., *Adhatoda vasica* Nees., *Barleria prionitis* Linn., *Asparagus racemosus* Willd., *Hemidesmus indicus* R. Br., *Holarrhena antidysenterica* Wall., etc.

83. Ecological studies on the evergreen forests.

R. K. ARORA, Poona.

The paper describes floristics of the evergreen forests of North Kanara, a high rainfall area along the western ghats. The ecological data have been collected by laying transects about a mile long, and taking quadrats of 16 ft. diameter along these at intervals of 25 ft. each.

The following evergreen communities have been established in the high rainfall areas of the district occurring mainly on red soil. The underlying rock may be granite, gneisses or laterite.

1. *Myristica-Hopea-Diospyros* community, in the forests of Anegundi, Yelvelli and Aratarri, in the vicinity of the Katgal town is the climax over most of the areas studied. The chief top storey species of this community are :—*Knema attenuata* (*Myriatica attenuata*), *Hopea wightiana*, *Diospyros microphylla*, *Dysexylum glandulosum*, *Vitex altiesima* and others. Second storey has *Olea dioica*, *Pterospermum heyneanum*, *Pterospermum acerifolium*, *Mallotus philippensis* and *Memecylon talbotianum*. The third storey contains *Psychotria*, *Leea indica*, *Calamus pseudotenuis* and of these *Psychotria* dominates. Ground flora is chiefly occupied by tree seedlings. Regeneration of *Myristica* and *Hopea* is abundant, followed by *Diospyros*. Most of the species show poor regeneration.

2. *Myristica-Hopea-Cinnamomum* community occurs along the gentle slopy areas of the Yan. The forest here has rather an open canopy, and the general vegetation is similar to the above community. Regeneration of *Myristica* and *Hopea* is high. *Diospyros* has a very poor regeneration and is absent as a tree species from this forest and only a few seedlings of this area met with. *Cinnamomum* seems to have replaced this species at Yan and shows good regeneration. *Calamus* is more prominent here than in the above community.

3. *Myristica-Polyalthia-Diospyros* community is developed on almost level areas and under better moisture conditions. Its composition differs from the above two communities. The chief top storey species are *Knema attenuata*, *Polyalthia fragrans*, *Diospyros microphylla*, *Artocarpus hirsuta*, *Machilus macrantha*, *Vitex altissima* and *Cinnamomum zeylanicum*, *Olea dioica*, *Flacourtia montana* and *Holigarna* are more prominent in the second storey. Unlike *Pterospermum* spp.,

which dominate in the above two communities *Leea indica* is the commonest shrub. *Diospyros* shows better regeneration than *Myristica* and *Polyalthia* indicating a change in the successional status of this community.

Gnetum ula, *Piper* and *Pothos*; *Diploclisia glaucescens* and *Calycopteris* are the common climbers in the three communities described above.

In the low evergreen areas, *Diospyros-Cinnamomum-Xylia*; and *Eugenia-Terminalia-Diospyros-Xylia* are the two communities which have been studied. Under better conditions these progress into higher evergreen forms. Linking stages of succession of evergreen communities on red soils are to be seen here.

84. Studies on the vegetation of Coorg, Western Ghats, India.

C. S. PURI and R. K. ARORA, Poona.

Coorg is situated along the western ghats between latitudes 11° N and 13° N and longitudes 75° and 76° 27′ East. On its north and north-east lie the drier portion of the Mysore State while towards its south and west, evergreen vegetation with lofty tall trees is met with.

The area is mostly hilly, with hills varying between an altitude of 2500′—5700′ above sea level. Tadiandomole at an elevation of 5700′ is the highest peak in Coorg.

Rainfall is very heavy averaging up to 500 cms. annually in many of the forest areas. The climate is monsoonic though moderate during most of the year, with temperature varying between 55° F and 95° F.

Geologically the area consists of unclassified rocks, mainly granites, gneisses and laterites. Red soil supports good evergreen forests.

Four vegetation types i e. Evergreen, deciduous, scrub and Grasslands are met with in the area. The distribution of these types is governed chiefly by (a) type of rock and soil, (b) the amount of rainfall and (c) biotic interference.

The high rainfall areas on red soil bear evergreen forests with species like *Knema attenuata*, *Dipterocarpus turbinatus*, *Diospyrus* app., *Cinnamomum zeylanicum*, *Noligarna* app., *Polyalthis fragrans*, *Syzygium* spp., *Elaeocarpus tuberculatus*, *Garcinia* spp., *Machilus macrantha*, *Litseas* and other *Lauraceae*, *Hopea wightiana*, *Euphorbia longana*, *Alea dioica*, *Kesua ferrea*, *Donelia roxburghii* and *Terminalia paniculata*. These forests have a distinct stratification and are generally three or four storeyed. The semi-evergreen vegetation met with at places chiefly consists of *Careya arborea*, *Dillenia pentagyna* and few others.

Moist deciduous forests of Coorg occur in areas which get a moderate rainfall between 125 cms.-160 cms. annually. These forests are generally developed on alluvial, blackish brown soils and are more common in the central and western part of Coorg. The chief species met with are *Tectona grandis*, *Lagerstroemia lanceolata*, *Garuga pinnata*, *Albizzia* spp., *Pterocarpus marsupius* with bamboo like *Dendrocalamus strictus* and *Bambusa* bamboos.

The low rainfall areas with rainfall of about 100 cms. or less annually bear dry deciduous forests which may degrade to scrubby areas, and patchy grass-lands due to biotic interferences. The chief components of these deciduous forests are :— *Anogeissus latifolia*, *Terminalia tomentosa*, *Lagerstroemia lanceolata*, *Madhuca indica*, *Diospyros melanoxylon*, *Buchanania lanzan* and others.

The scrub on red lateritic soil bears evergreen species of *Pavetta*, *Ixoras* and others; while on deciduous dry zone, its components are coppiced trees of *Anogeissus*, *Lagerstroemia*, etc. with scandent shrubs of *Zizyphus* and *Acacia*.

The grasslands contain *Eulalia, Arundinella, Themeda* and others. In swampy places *Eriocaulon* sp., *Typha* and others are seen.

The preliminary list includes 257 species.

85. Ecological studies of some deciduous forests of North Canara.

R. K. ARORA, Poona.

The deciduous forests of North Kanara are mainly distributed on alluvial soils in somewhat low rainfall areas in the eastern part of the district. The present observations are based on data collected during survey of the areas of Haliyal, Sambrani, Bhagwati, Dandeli and the adjoining region of Dharwar.

The soil in these areas is blackish in colour with mixed humus and at some places it may be gravelly. Most of the forests are developed on the alluvia of the various rivers which drain the district and support good teak and/or bamboo communities. The following distinct types have been recognised :—(a) Teak forests, (b) Bamboo forests; (c) Teak-bamboo mixed forests and (d) Forests without teak or Bamboo—*Lagerstroemia-Anogeissus* type forests.

The following communities described below from different areas of the district are mainly edaphic or bio-edaphic in origin :—

1. *Tectona-Terminalia-Phyllanthus* community is developed on almost level areas. *Terminalia tomentosa, Emblica officinalis, Tectona grandis, Lagerstroemia lanceolata, Schleichera oleosa, Balberga latifolia* are the chief dominant species. *Grewia, Bridelia* and *Anogeissus* are rather poorly represented. *Zizyphus, Gardinia, Randia, Carissa, Helicteres* are the common shrubs with climbers of *Acacia concinna, Asparagus, Dioscorea, Vitis and* others. *Terminalia* and *Phyllanthus* show high regeneration as compared to *Tectoma. Leea macrophylla, Curculago, Curcuma, Rungia* and others are present in the ground layer.

In the mixed Teak-Bamboo areas the following two communities are recognised :—(1) *Dendrocalamus-tectona-Adina;* and (2) *Dendrocalamus-Tectona-Grewia. Dendrocalamus* dominates in both these communities. *Tectona grandis* is better represntted in *Dendrocalamus-Tectona-Adina* community with a percentage occurrence of 90. Its other common associates here are : *Grewia tiliaefolia, Albizzia odoratissima, Dalbergia* sp., *Diospyros* and others, while under the 2nd community, *Adina cordifolia, Butea monosperma, Mitragyna parvifolia, Madhuca indica, Buchanania lancan* are chiefly seen. Regeneration of Teak is better here than under *Dendrocalamus-Tectona-Grewia* community, while Bamboo has a poor regeneration in both.

Lagerstroemia-Anogeissus Terminalia community is developed in areas where Teak and/or Bamboo are missing. The trees are coppiced and the area is subjected to biotic interferences. The forest canopy is open. *Lagerstroemia, Anogeissus, Terminalia* with other deciduous species form the major vegetation of these areas. *Anogeissus* is better represented.

The above communities are mostly restricted to level areas or occur along gentle slopes. Along hilly tracts in deciduous areas where steep slopes occur and the altitude is higher, the vegetaton differs. While teak is prominent at the base of these hills, it disappears higher up. *Anogeissus* replaces it here, while near the top of these hills *Zylia becomes* dominant. In these areas *Xylia-Phyllanthus-Anogeissus, Xylia-Dendrocalamus-Grewia* and *Xylia-Dendrocalamus-Terminalia-Dillenia* communities have been recognized. Regeneration of teak and/or Bamboo is poor in these areas showing that these communities are progressing into semi-evergreen types with *Xylia* dominating like the ones met with in red-type series.

86. A preliminary study on the vegetation of drier parts of Bombay, Mysore and Madras between latitude 8.2°—17.6° and longitude 76.2°—77.6°

B. M. WADHWA, Poona.

The study on the vegetation of these parts includes the districts of Sholapur, Bijapur, Raichur, Guntakul, Bellary, Kolar and Cape-Comorin. The area is situated between the Lat. 8·2°N to 17·6°N and 76·2°E to 77·6°E. The annual rainfall varies from 37·5 cms. to 67·5 cms.

The area is mostly rocky with sandstone, gneisses, granite, Deccan Trap and at places amygdaloidal rocks are also met with. The trappean basaltic rock which at places is covered by alluvial clay while at others is covered with calcareous tuffa or murumy soil which do not support any tree growth.

The soil is shallow varying from sandy loam to pure sand. The soil colour varies from red, chocholate brown to black.

The common plants of the areas are given below :—

Acacia arabica, Acacia catechu, Acacia latronum, Aegle marmelos, Albizzia amara, Albizzia lebbek, Albizzia odoratissima, Anogeissus latifolia, Bauhinia racemosa, Bridelia squamosa, Carissa carandus, Carissa spinarum, Cassia fistula, Chloroxylon swietenia, Dalbergia paniculata, Diospyros montana, Dodonaea viscosa, Dolichandrone atrovirens, Erythrina variegata, Syzygium cumini, Euphorbia nerifolia, Euphorbia tirucalli, Ficus asperrima, Ficus gomerata, Flacourtia indica, Randia dumetorum, Opuntia dillenii, Pongamia pinnata, Mitragyna parvifolia, Strychnos potatorum, Wrightia tinctoria, Zizyphus oenoplia, Meyna laxflora, Rhus mysorensis, Mundalea sericea, Feronia limonia, Lasiosiphon eriocephalus, Santalum album, Grewia tenax, Grewia tiliaefolia.

Among the ground flora and climbers *Cassia auriculata, Tephrosia purpurea, Argyreia cuneata, Lantana indica, Commelina* sp., *Cyanotis* sp , *Rivea hypocrateriformis, Hemidesmus* sp., *Rhynchosia minima, Atylosia scarabaeoides, Tridax procumbens, Leucas stelligera, Evolvulus alsinoides, Boerhaavia diffusa, Achyranthes aspera, Jasminum* sp., *Melanocenchrus, Heteropogon* sp., *Chrysopogon* sp., *Cynodon dactylon, Datura stramonium, Tribulus terrestris, Scilla indica, Asparagus asiaticus Capparis* sp., *Cleome viscosa, Indigofera linifolia,* etc. are common.

The most interesting and important plants in the area is *Prosopis spicigera,* which grows nicely, and shows a typically desert habit. The other desert plant, which grow well, are *Salvadora oleoides, Cressa cretica Aerva javanica, Capparis decidua, Tephrosia purpurea* etc. There also grows a number of species of *Euphorbia, Grewia* etc., which occur typically on rocky habitat in the Indian desert and the Aravallis.

87. A preliminary study on the vegetation of Central India.

PURI G. S. and B. M. WADHWA, Poona

The Central India comprises of the erstwhile princely States of Madhya Bharat, whole of Bhopal and Vindhya Pradesh. The Central India is situated between Latitude 20·5°N—27·5°N and Longitude 75 5°E—80°E, and has an annual rainfall ranging between 130 to 257·5 cms.

The principal rock formation found in the area are Recent alluvial, Deccan Trap and Vindhyan limestone, granite, gneisses, sandstones etc. The geological conditions seem to affect greatly the distribution of forest communities.

The forest fall under Tropical dry deciduous, Tropical moist deciduous, Tropical semi-evergreen and Sub-tropical forest types. The most common forests are of Teak, although Butea forest and mixed Teak forest are also met with at many places. The Teak forest are found on Trap rocks; and riverine alluvial as distinct successional stages.

The common associates of wet type Teak forest are *Ougeinia oojeinensis, Terminalia tomentosa, Anogeissus latifolia, Adnia cordifolia* and *Dalbergia latifolia* and of dry type Teak forest are *Terminalia tomentosa, Boswellia serrata, Lagerstroemia parviflora, Diospyros melanoxylon, Careya arborea, Ougeinia oojeinensis, Sterculia urens, Buchanania lanzan, Pterocarpus marsupium, Butea superba, Lannea coromandelica and Aegle marmelos.*

In the mixed Teak forest the commonest species is *Terminalia tomentosa.* The other common species are *Chloroxylon swietenia, Diospyros melanoxylon, Madhuca indica, Emblica officinalis, Lagerstroemia parviflora, Soymida febrifuga, Schleichera oleosa, Buchanania lanzan, Adina cordifolia, Acacia catechu, Dalbergia latifolia, Ougeinia oojeinensis, Butea monosperma, Aegle marmelos, Gardenia latifolia, Elaeodendron glaucum* and *Anogeissus latifolia.* The *Nyctanthes arbor-tristis* and *Helicteres isora* are common in the undergrowth.

The preliminary list of plants of Central India includes 400 species, both collected and identified by the authors.

88. Study of the vegetation of Sutgatti Forest in the Western Ghats.

B. S. AHUJA, Poona.

The paper describes the vegetation of Sutgatti forest in the Belgaum district, situated along Poona Belgaum road at an altitude of 1200 3000 ft. above sea level

The soil is black having stones and gravel on the surface at some places. At lower layers it is mixed with nodular pieces of lime and small fragments of disintegrated trap rocks.

The climate is typically monsoonic with an average annual rainfall of 114 cms.

The vegetation can be recognised into four dominant types viz. evergreen, deciduous, scrubs and grasslands; most common type being deciduous forest.

The flora at present comprises of about 200 species and the following families seem to be well represented—

1. *Leguminosae.* 2. *Gramineae.* 3. *Cyperaceae.* 4. *Malvaceae.* 5. *Ebenaceae.* 6. *Euphorbiaceae.* 7. *Acanthaceae.* 8. *Compositae.* 9. *Verbenaceae.* 10 *Combretaceae.*

The common trees of the area are—

Pongamia pinnata Pier., *Tectona grandis* L.f., *Terminalia paniculata* Roth., *Morinda tinctoria* Roxb., *Chloroxylon switenia* D.C., *Lagerstroemia parviflora* Roxb., *Santalam album* Linn., *Cordia macleodii* Hk.f. & T., *Careya arborea* Roxb., *Butea monosperma* O. Kuntze., *Anogeissus latifolia* Wall., *Cochlospermum religiosum* Alston.

The undergrowth has the seedlings of trees the names of which are given above and the herbs present are *Chrysopogon montanus* Trin., *Alternanthera sessilis* R. Br., *Glossocardia linearifolia* Cass., *Setaria glauca* Beauv., *Evolvulus alsinoides* Linn., *Amaranthus spinosus* Linn., *Oxalis corniculata* Linn., *Achyranthes aspera* Linn.

The climbers and shrubs are *Diploclisia glaucescens* Diols., *Dioscorea oppositifolia* Linn., *Hemidesmus indicus* R. Br, *Lantana camara* Linn. *Dodonaea viscosa* Jacq., *Acacia torta* Craib., *Randia brandisii* Gamble., *Helicteres isora* Linn.

89. Studies in the vegetation of Deccan Trap Country—II. Plants of Belgaum and Kolhapur area.

B. S. AHUJA, Poona.

The area covered in this investigation includes the districts of Belgaum and Kolhapur, between latitude 15·5°N and 17 2°N and longitude 73 7°E and 75·5°E. The adjoining areas, northern area of Deccan Trap, comprising of the districts of Poona, Satara, Thana, Sholapur and Ahmednagar have been studied by Puri and Jain (1958) and of the southern territory North Kanara, a flora has been prepared by Puri and Arora (1958). The forest vegetation studied is more or less of open evergreen type except in small parts of Kolhapur district which has deciduous scrubs and grasslands.

This area is mountaneous, cut up by isolated plateaux and narrow valleys. It has an average altitude of 1200 ft.—3000 ft. above sea level.

The climate is typically monsoonic with an average annual rainfall of 150 cms.

The flora studied at present comprises of about 750 spp. The most common families being *Leguminosae, Gramineae, Compositae, Euphorbiaceae, Labiatae, Malvaceae, Acanthaceae, Cyperaceae, Orchidaceae* and *Rubiaceae.*

The most common plants in the area are—

Terminalia bellerica Roxb., *Terminalia paniculata* Roth., *Anogeissus latifolia* Wall., *Lagerstroemia parviflora* Roxb., *Diospyros candolleana* Wt., *Diospyros melanoxylon* Roxb., *Cordia dichotoma* Forsk. f., *Ehretia laevis* Roxb., *Tectona grandis* L.f., *Santalam album* Linn., *Mallotus philippensis* Muel., *Flacourtia indica* Merr., *Abutilon indicum* Sweet., *Helicteres isora* Linn., *Zizyphus mauraliana* Lamk., *Zizyphus oenoplia* Lamk., *Zizyphus xylopyra* W., *Randia brandisii* Gamble., *Meyna laxiflora* Robyns., *Ixora arborea* Roxb., *Lantana camara* Linn , *Carissa congesta* Wt., *Grewia tiliaefolia* Vahl., *Diploclisia glaucescens* Diels., *Dioscorea oppositifolia* Linn., *Cryptolepis buchanani* R. & S., *Vernonia cinerea* Less., *Calotropis gigantea* R.Br., *Apluda varia* Hack., *Themeda triandra* Forsk., *Scurrula paresitica* Linn., *Aerides macolosum* Lindl.

90. Vegetation of Tehri Garhwal District (North West Himalayas).

RAJ KUMAR GUPTA, Poona.

Tehri Garhwal is a small erstwhile princely state situated between Lat. 30·3° and 31·18° and Long. 77·53° and 79·28° having an area of about 4500 sq. miles. It has a typical vegetation of oaks and conifers. In the district, oaks are the Climatic Climax Vegetation and Conifers come up as a result of the disturbance, either naturally (land slide, avalanche, glaciation) or by artificial means such as human interference in the form of shifting cultivation, felling, fire etc.

The climate of the district is very much diversified on account of the varied physical features. The lower and outer ranges have a climate similar to the plains, whilst the higher peaks are always covered with perpetual snows. The configuration of the ground exerts a great influence on the distribution of rainfall. Rainfall at places that are protected by ridges is very small but at higher altitudes in the interior of bills it is heavier, but not as much as along the outer hills.

The geology and mineralogical composition of the original rock type exerts a great effect on the growth, development and succession of forest vegetation. The chief types of vegetation that have been studied in relation of rock and soil are as follows :

Alpine pasteurs and Grass lands :—Above the limit of tree growth on granite formations this community is seen. Its chief associates are ***Betula utilis*** Don., ***Rhododendron campanulatum*** Don., in the upper half and ***Quercus semecarpifolia*** Smith., ***Abies webbiana,*** Spach., are on the lower half. Some of the common herbs are *Anemone rivularis* Buch-Ham., *Corydalia meifolia* Wall., *Gentiana argentia* Royle., *Picrorhiza kurrooa* Benth., *Pedicularis pectinata* Wall., *Primula involucralia* Wall., *Valeriana wallichii* DC., and *Rancculus hirtellus* Royle.

Forests and Pasteur lands on Morainic deposits :—On the glacial morainic deposits pure *Abies* community is present, but at some places it is mixed with *Picea smithuana* Beiss., Aesculus indica Colebr., Juglans regia Linn. and Acers

Abies community :—In this zone *Quercus semecarpifolia, Bies* and *Betula utilis* occur in mixtures among themselves and with other species such as *Cedrus deodara* Hk. f., *Pinus excelsa* Wall., *Taxus baccata* Linn., *Prunus padus* Linn., *Aesculus indica* Colebr., and Acers on the unglaciated regions. At the top, forest of *Betula utilis* Don., predominates and *Quercus semecarpifolia* Smith., and Abies are present as subsidiary species.

Abies pindrow Spach., *Picea smithiona* and *Q. semecarpifolia* Smith. community :—This zone is developed mainly on the southern slopes and in unglaciated hotter aspect of morainic deposits. Quercus semecarpifolia Smith. predominates on the spur, while in gullies *Abies pindrow* Spach predominates. Oaks are very few forming at places an understorey in the spruce community

Quercus semecarpifolia community :—Below the *Abies* community *Quercus semecarpifolia* is present on quartsite, schist and shale formations and is associated chiefly with *Picris ovalifolia* Don., *Rhododendron arboreum* Smith., *Taxus baccata* Linn., *Aesculus indica* Colebr. and *Juglans regia* Linn.

Pinus excelsa and Cedrus deodara community : No extensive natural forests of *Cedrus deodara* are found in the district. But the growth is localised in patches. At low elevations *Cedrus deodara* is associated with *Pinus excelsa* and *Pinus roxburghii* while *Deodar-kail', 'Deodar-kail and chir'* combinations are frequent. *Quercus incana* with *Rhododendron arboreum* Smith. and *Picris ovalifolia* Don. occupy damp places.

Quercus dilatata community :—This zone extends between altitude 7500—9000 ft. along '*nalas*' associated with *Populus ciliata* Wall., *Rhododendron arboreum* Smith., *Juglans regia* Linn., *Picris ovalifolia* D. Don., and *Cedrus deodara*. On the upper limit it is associated with *Q. semecarpifolia* Smith community.

Quercus incana community :—This zone overlies *Pinus roxburghii.*, its chief associates are *Rhododendron arboreum* Smith., *Picris ovalifolia* D.Don., and *Pyrus pashia*. Scattered chir is sometimes present at places where the climax vegetation is disturbed.

Pinus roxburghii community :—This community forms extensive forests in the district. The crop is generally pure, except at low elevations, where it is mixed with other species such as *Acacia catechu, Mallotus phillipensis, Anogeissus latifolia, Terminalias* etc. Towards the top and shady places in gullies *Q. incana* Roxb., *Picris ovalifolia* D. Don, *Rhododendron arboreum* Smith., *Myrica nagi*, mixes up in varying proportion according to the degree of exposure and moisture content of the soil.

Euphorbia royleana and Carissa opaca (*C. spinarum*) *Community* : On quartzite and conglomerates on dry hot aspects this community is seen. Its chief associates are *Rhus parviflora, Mallotus phillippinensis, Zizyphus, Calotropis, Colebrookea oppositifolia* etc. The successional status of all these communities have been given. In general the conclusions from this area are in conformity with studies of Puri from the Western Himalayas.

90a. Ecology of Chota and Bada Simla Hills at Jabalpur.

S. C. PANDEYA and L. R. PATIL, Jabalpur.

Chota and Bada Simla are two adjoining hills situated east of the town of Jabalpur. They are made up of lameta beds which are fluviatile deposits resting on older rocks. The hills are under severe erosion and extensive area is exposed with lime clays, kankar and nodular mass. Rainwater transports calcareous clays downslopes.

The hills have been studied phytosociologically and it has been observed that the vegetation can be divided into three zones, viz., top, upper and lower slopes and foot of the hills. Trees grow like a collar round the top. Shrubs and low trees occupy lower slopes and mainly grasses dominate the foot.

Boil profile at the foot of the hills has been studied. Clay predominates the soils which are having medium exchangeable calcium.

Thus trees probably least tolerate calcium and grow only round the top. Next come the shrubs occupying the lower slopes. Grasses probably can withstand high calcium. Scanty vegetation is correlated with high percentage of clay in soils. Root studies are in progress.

90b. Contributions to the Ecology of Acanthospermum hispidum DC.

S. C. PANDEYA and R. S. GOSWAMI, Jabalpur.

Acanthospermum hispidum DC., belonging to the family Compositae, is a new species to India. It was first noticed by Rev. Fr. Santapau in 1945. Since then it has become wide spread throughout India. It is a herb going upto 5 ft., when under competition. It comes up in July and dries by November; with winter rains it may sprout again only to dry by April.

As a start to search the causes for the wide spread distribution of this species the following observations have been made :—

1. Culture experiments :

(a) Plants have been grown in different types of soils, viz., alluvium, laterite type, calcareous, black cotton, sandstones and granitic. The plant shows best growth in alluvium.

(b) 4 sets of pots, as given above, were prepared, one set was watered daily, second watered alternate days, third weekly and fourth was left in open and received only the rain water. First and second sets have shown better growth in all types of soils.

2. An analysis of soils collected from different places reveals that the species grows best in sandy soils having good percentage of soil moisture. Length and breadth of leaves is greatest in such places.

3. Osmotic pressure studies of the plant have further confirmed the above observations.

IV. PHYSIOLOGY

91. Soil moisture in relation to wilt of gram *(Cicer Arietinum L).* caused by *Sclerotium Rolfsii* sac.

S. B. MATHUR, Agra.

Influence of three levels of soil moisture (10%, 15% and 20% on oven dry weight) was investigated on seedling mortality in gram (*Cicar arietinum* L.) caused by *Sclerotium rolfsii Sacc.* The seedlings were raised in glazed pot cultures kept in glass house and the soil was infested with the inoculum grown on corn-meal sand medium four days before sowing. Six seeds were sown per pot, and five pots were allotted for each treatment. Controls (without inoculum) were also maintained. Observations on seedling mortality were recorded for 44 days after sowing at intervals of 11 days. Total percentage of seedling mortality for each level of soil moisture and also the percentage mortality at each interval indicates that the percentage seedling mortality is the highest (93%) at 10% soil moisture level and decreases progressively with increase in soil moisture levels. (53% and 30% at 15% and 20% soil moisture levels respectively). Further, the rate of mortality is also higher in 10% than in 15% or 20% moisture levels as shown by the number of days taken for total mortality.

92. An acid—base indicator pigment from a Streptomyces spp.

P. P. MUKHERJEE, R. SINHA and P. NANDI, Calcutta.

A pigment was isolated from a *Streptomyces* spp. The pigment was blue in alkaline and red on acid side of the pH. The culture was grown in CZ—Dox medium supplemented with 0.2% malt ext. and at pH 6·8 in staticnary flasks. In shake flasks, neither there was production of pigment nor growth was observed. The pigment was pptd. out by the addition of 2 N HCl. It was centrifuged out and washed well with water and finally dried The pigment showed positive phenolic reaction. Solubilities of the pigment in different solvents were observed The pigment was separated chromatographically on cellulose powder column and five fractions were obtained.

These five fractions were supported by counter current distribution technique.

93. Effect of pH on the production of a fungistatic substance by a new strain of *Streptomyces Griseu* (Krainsky *em.* Waksm. *et al)* Waksman *et al*

K. C. BASU CHAUDHARY, Agra.

A new strain of *Streptomyces griseus* (Krainsky em. Waksm. et al) Waksman et al reported to produce a fungistatic substance (Basu Chaudhary 1956) active against *Alternaria solani* and *Helminthosporium oryzeae* has been investigated in relation to the effect of different initial pH ranges (3·4, 5·4, 6·6, 7·0., 8·2 and 9.0) on the growth of the Actinomycetes and the metabolism of the active substance, wherein it has been found that the growth of the organism was almost nil in pH levels 3·4 and 5·4, also the fungistatic activity was correspondingly low or none. As the pH was raised both the growth, expressed in terms of mycelial dry weight, and the production of the fungistatic substance increased optimum being at 7·0. Growth and production of the active substance were closely related with initial pH of the medium.

94. Nitrogen nutrition of *Helminthosporium rostratum* Drechs.

G. P. AGARWAL, Jabalpur.

The paper describes the growth and sporulation of *Helminthosporium rostratum*, an isolate from the foot rot of wheat, on various nitrogen compounds.

The fungus could not grow in the complete absence of nitrogen from the culture medium. Asparagine supported the best growth followed by sodium nitrate, ammonium nitrate, ammonium sulphate, ammonium chloride, Di-valine, sodium nitrate, urea, potassium nitrate and peptone. This adds *H. rostratum* to the small list of fungi which grow on nitrites. Role of pH in the utilization of sodium nitrite is discussed. The fungus as a result of its metabolic activity changed the final reaction of the culture medium. Nitrite nitrogen could be utilized in fairly acidic medium.

95. Influence of different carbon and nitrogen ratios on the growth and sporulation of the two Dry Rot strains of *Fusarium coeruleum* (Lib.) Sacc.

G. P. AGARWAL, Jabalpur.

The paper deals with the influence of different carbon nitrogen ratios on the growth and sporulation of the two strains of *Fusarium coeruleum,* the incitant of Dry Rots of potato and *Colocasia antiquorum,* in liquid medium adjusted to pH 6·4, the optimum for the two fungi. Eighty different combinations have been tested with glucose and potassium nitrate as sole sources of carbon and nitrogen. The organisms could grow and develop good sporulation even in the lowest amounts of carbon (0 2 gm. per litre) and nitrogen (0·0125 gm. per litre). The maximum of carbon and nitrogen used was 16 gm. per litre and 4 gm. per litre respectively. The optimum C/N ratio for the growth and sporulation of both the strains was 16 gm. carbon/2 gm. nitrogen per litre. The data of the experiments indicate that the greater uptake of carbon by the organisms is possible without a corresponding increase in the amount of nitrogen whereas the greater uptake of nitrogen is limited by the supply of carbon.

96. Effect of trace elements on the growth and sporulation of some pathogenic fungi.

G. P. AGARWAL, Jabalpur.

The influence of four trace elements (Zn, Mn, Cu and Fe) singly and in all possible combinations, on the growth and sporulation of *Curvularia penniseti* isolated from *Pennisetum typhoideum* and the two strains of *Fusarium coeruleum* isolated from dry root of *Colocasia antiquorum* and potato, in the liquid medium has been dealt. The three fungi behaved differently to the various treatments. The trace elements, singly or combined, increased the dry weight of the organisms and appeared to be essential for their sporulation. The best dry weight and sporulation of the fungi was recorded when all the four elements were combined together.

97. Ultraviolet irradiation of Aspergillus niger—I. Dose Effect curve of ultraviolet radiation in Asp. niger.

A. K. MISHRA and P. NANDI, Calcutta.

The aqueous spore suspension of *A. niger* was irradiated with ultraviolet of wavelength 2537 A emitted by a low pressure 4-watts G.E. UV germicidal lamp. The radiation energy was (calculated with the help of dosimeter) 100 ergs/mm^2/sec. The time periods of irradiation were 4, 8, 12, 16 and 20 minutes. The rate of killing due to radiation increased with higher doses but the rate of rise in mutation of frequency is not parallel to that of killing rate. The mutation increases to a maximum and then decreases rather erratically. The highest mutation frequency was observed at a dose rate of 12-minutes exposure.

The morphological and the biochemical mutants were 9·1 and 3·5 per unit respectively. The former showed a wide range of variation of the colour of the conidia, structure of the colonies on agar plates and pigment produced on the reverse of the colonies. The following deficient strains were observed among biochemical mutants :—arginine, proline ornithine, citrulline, glycine, leucine, methoinine, cystine, cysteine, phenylalanine, lysine, issoleucine, histidine, p-aminobenzoic acid, folic acid, nicotinic acid, pyridoxine, thiamine, biotin, choline, inositol, adenine, hypoxanthine, cystine and uracil.

98. Ultraviolet irradiation of Aspergillus niger—II. Effect of pre-incubation on the frequency of mutation and rate of killing.

A. K. MISHRA and P. NANDI, Calcutta.

Of the various factors modifying the mutagenice effect ultraviolet, pre-incubation of spores plays a definite role. Spore suspension of *A. niger* were incubated for 0, 2, 4 and 6 hours before irradiation. The results show that the rate of killing due to irradiation increased with the prolongation of the period of incubation. The rate of mutation increased only upto 4 hours of preincubation beyond which it declined significantly.

99. Ultraviolet irradiation of Aspergillus niger—III. Photoreactivation.

A. K. MISHRA, S. L. CHAKRABARTY and P. NANDI, Calcutta.

In microorganisms certain changes are produced by ultraviolet radiation of wavelength about 2500 A units. The effect of radiation can be counteracted if irradiated organisms are reexposed to visible light and ultraviolet radiation of higher wavelength which is termed as photoreactivation.

In course of our investigation on induced mutation in *Aspergillus niger* by ultraviolet radiation samples of irradiated spore suspension were exposed to (a) 20-watt Phillips Day Light lamp, (b) diffused light of the laboratory room and (c) direct sunlight for carying periods of time at 35 1°C. The effect photoreactivation was observed in all cases and the most effective dose was 30 mins. exposure to direct sunlight. The percent survival increasaed from 4·6 to 12·1 in this case due to reversal effect of light of higher wavelength.

100. Transplantation studies on Sal (Shorea robusta) seedlings and some associated weed species.

HARISH P. BHATNAGAR, Dehra Dun.

Adverse moisture balance is supposed to be one of the many causes of the failure of natural regeneration of sal (*Shorca robusta* Gaertn.). In order to assess the comparative utilisation of and competition for available moisture, studies on transpiration of sal seedlings in weeded and unweeded plots were carried out along with a common weed species (M. philippensis).

The study revealed clearly that the sal seedlings are deprived of soil moisture to a significant extent by the weed species. This is mainly due to the competition, for available water, exerted by the presence of other species in abundance. *Mallotus philippensis* is probably the chief competitor for soil water, its rate of transpiration being comparable to that of sal.

The study serves to confirm the desirability of cutting weeds specially *Mallotus philippensis* bushes in the early summer before rains (April-May), when the period of greatest competition for soil water begins and which is also the period of maximum growth of sal seedlings, and again in October and November when there is renewed competition for soil water.

101. Physiological basis of Usar (Alkali) Tolerance—I. Absorption of Na, K and Ca.

K. L. MUKHERJEE, K. SATYANARAYANA and C. C. RAO, Varanasi.

An effort has been made to investigate the causes for the alkali tolerance of Eragrostis tenella in the soils at the vicinity of Varanasi. Na, K and Ca in the component parts of the plant have been analysed by means of a flame photometer. The analyses show the influences of these cations over each other regarding their absorption and subsequent distribution within the plant. The absorbing organ shows wide fluctuations in the contents of these elements under normal and alkaline conditions, but their subsequent distribution in the plant body is judged by the behaviour of the elements towards the plant growth, specially under unfavourable edaphic conditions. Toxic elements (e.g. Na) may possibly be retained by the roots and not allowed to translocate freely inside the plant body. A sort of regulatory mechanism is perhaps existing in roots which govern the distribution of unhealthy elements for plant growth. Stems act passively in regularising this translocation process e.g. higher calcium content in the stem shows an antidoting effect in the progress of sodium from the roots towards the leaves. As a result of these, the leaves are kept as far as possible in a state of physiological balance for a successful functioning of food manufacture and are least effected by changes in the edaphic conditions.

Further work is in progress with other alkali tolerant species to confirm the above findings.

102. Physiological basis of Usar (Alkali) Tolerance—II. Relative absorption of water and sodium carbonate.

K. L. MUKHERJEE and L. V. VENKATARAMAN, Varanasi.

The comparative tolerance of Eragrostis tenella, Eleusine sp., and Cyperus rotundus to withstand high alkalinity due to Na_2CO_3 in the culture medium has been worked out. The susceptible species Cyperus are found to possess certain characteristic features different from those of the tolerance species Eleusine and Eragrostis. They are poor in their water absorbing capacity in an alkaline medium and probably possess a less powerful regulatory mechanism in roots in restricting the incoming and subsequent distribution of unhealthy elements like Na. Tolerant species like Eleusine can stand a very high concentration of Na_2CO_3 in the root environment but at the same time possess considerable water absorbing and alkali accumulating capacity with a high ratio of the amounts of absorbed water/absorbed Na_2CO_3. On the basis of the findings of the present experiment and earlier experiments it wll perhaps be not too impertinent to deduce the presence of a sort of regulatory mechanism in the roots of alkali-tolerant species which governs a selective absorption and distribution of toxic elements like Na in the plant body.

103. Physiological studies on salt-tolerance of crop plans.—V. Use of IAA to overcome depressing effect of sodium sulphate on growth and maturity of wheat.

M. N. SARIN and I. M. RAO, Agra.

Local saline and alkaline soils contain a fairly large amount of sodium sulphate, even upto 0·209% (on air-dry soil). Reduced crop growth or even complete failure is a common feature in such areas. The present study was undertaken to find out the adverse influence, if any, of a fairly high concentration of sodium sulphate on growth and maturity of wheat and to evaluate the possibility of its neutralisation by treatment with the growth promoting substance, IAA.

Seeds of wheat C. 591 were subjected to presowing soaking (half-immersion) in 5 ppm. of β-indolylacetic acid (IAA) solution and in distilled water for 24 hours and were sown in pots along with untreated seeds. Two series were maintained for each treatment : (i) with 0·1% (in 1955-56) and 0·15% (in 1955-57 and 1957-58) of sodium sulphate added to the soil, (ii) normal soil without any added sulphate. The experiment was conducted during three years i.e. in rabi (winter cropping season—October to April) of 1955-56, 1956-57 and 1957-58.

The lower dose of sodium sulphate (0·1% on air-dry-weight of the soil) did not decrease the shoot-dry-weight and yield of grain, but the higher dose (0·15%) was definitely inhibitive; the average reduction in shoot-dry-weight and yield of grain due to the sulphate for the three years amounted to nearly 12% and 16% respectively.

Presowing soaking of wheat seeds in IAA solution increased on an average the shoot-dry-weight by 19% but scarcely affected the yield when the plants were grown in normal soil. In the 'sulphate-soil', however, IAA-treatment increased significantly shoot-dry-weight and grain-yield of the plants by 50% and 31% respectively over the untreated set; further, plants from the IAA-treated seeds, grown in the 'sulphate soil', showed even better growth and yield than those from untreated seeds sown in normal soil, the average increases in the shoot-dry-weight and grain-yield being 34% and 13% respectively. It clearly shows the utility of IAA-treatment to overcome the depressing effect of the sulphate in the soil on growth and maturity of wheat plants. Presowing soaking of seeds in distilled water gave erratic results; in the saline soil it was definitely harmful to the yield of grain.

The mechanism of the sulphate-injury is discussed and the use of synthetic phytohormones in crop husbandry is advocated.

104. The effect of unsaturated Lactone (δ-Hexeno) on the esterification of inorganic phosphate in higher plants.

S. K. ROY and (MISS) MADHURI DUTTA, Calcutta.

Germination of seeds are known to be associated with an increased respiratory and enzymic activities. The germination inhibitors, unsaturated lactones inhibit respiration, but little is known of this effect on phosphorus metabolism in higher plants. Experiments were therefore carried out to study the effect of δ-hexenolactone on the course of esterification of inorganic phosphate in seeds whose germination was inhibited by the lactone and also in seeds of the same age but grown normally. The plant materials were incubated in a buffer solution containing P^{32} in the form of $Na_2HP^{32}O_4$ in presence of different concentrations of the lactone and after two hours the acid soluble phospho-compounds were extracted in TCA solution and fractionated into the usual "Barium-insoluble" and "Barium-soluble alcohol-insoluble" parts. The sodium salts of the esters were obtained and they were analysed by paper chromatography and autoradiography. The compounds were identified by chromatography and R_f and the radioactivity in each spot was determined to ascertain the relative distribution of the P^{32} in the different compounds.

The results reveal that the most significant effect of the lactone was a retardation of the uptake of phosphate, thereby confirming the earlier suggestions that lactones act by affecting the membrane permeability in a way as to prevent the entry of soluble nutrients in the cells. This effect was proportional with the increasing concentration of the lactone but was less so on seeds germinated normally. Of the little P^{32} taken up, a comparatively higher fraction was recoverable as inorganc phosphate in the lactone-treated seeds. The esterification was disturbed but to a lower extent. It was noticed that increasing age of the normally germinating seedlings increased their resistance to the lactone effect, as the effect of the lactone on the 5 days' old seedlings was hardly discernible. ATP, ADP, and AMP imbibed a comparatively higher activity in the lactone treated seeds and this would require a further investigation of the effect of the lactone on energatic phosphorylation. It is suggested that the germination inhibitation by δ-hexenolactone is associated with an inhibition of the process or processes responsible for the appearance of enzyme activity on germination.

105. Location of Photosynthetic Products in green leaves.

D. BASU and S. P. SEN, Calcutta.

An investigation has been undertaken to study the distribution and localisation of the products of photosynthesis in the leaves of Biloxi Soybean and *Antigonum leptopus*.

Two week-old Biloxi Soybean seedlings and leaves of *A. leptopus* were allowed to take up $Na_2HP^{32}O_4$ from a nutrient solution of pH 6.0 with or without $C^{14}O_2$ in light. The leaves were homogenised in a Waring blendor in 0.5M sucrose solution, the cell debris removed by filtration through several layers of cloth followed by low and high speed centrifugation. The chloroplasts spun down at high speed were washed further with sucrose solution, the supernatant solutions combined and cold acetone added to 60% saturation. The flocculent precipitate formed on standing for 24 hours at 0°C was washed repeatedly with cold 60% acetone and dried. Radioactivity of individual fractions were counted with an end-window β-counter.

When $Na_2HP^{32}O_4$ was supplied through the roots of intact soybean plants the specific activity of acetone-ppt. was found to be $1\frac{1}{2}$ times that of the chloroplast; 80% of the chloroplast activity could be extracted with 80% ethanol. When allowed to photosynthesise in an atmosphere of $C^{14}O_2$ for 5 min., the two topmost leaves were found to possess a photosynthetic rate higher than the lower ones. When the compounds were separated on paper chromatograms, compounds in the nucleiotide area were found to be formed at a rate much higher than the phosphate esters in these leaves.

When $Na_2HP^{32}O_4$ was fed through the petioles of *A. leptopus* for 90 mins. followed by photosynthesis in $C^{14}O_2$ for 5 mins. the distribution of radioactivity in chloroplasts was found to possess a relatively small fraction of total radioactivity. 20% of the water soluble products could be precipitated with acetone. Kinetic studies on $C^{14}O_2$ fixation with leaf discs indicated a linear relationship between the incorporation of C^{14} in the acetone precipitable substances and time. In other water-soluble components, however, the rate was relatively slow for the first 3 mins followed by a sharp rise. Activity in the chloroplasts also increased with time. Analysis of the acetone precipitable substances indicated a preponderance of phosphate esters.

106. Effect of nucleases on photosynthetic reactions.

B. B. BISWAS and S. P. SEN, Calcutta.

It has been suggested that nucleic acids have important roles to play in the synthesis of proteins, polysaccharides etc. It was considered worthwhile to investigate whether the CO_2 fixation reactions in photosynthesis are also nucleic acid controlled. Cells of *Nostoc muscorum* and *Chlorella pyrenoidosa* were incubated with $NaHC^{14}O_3$ in presence of light for 2 hours after treatment with DNAase or RNAase. It has been observed that the total amount of CO_2 fixed is lowered by treatment with the nucleases, the inhibitory effect of DNAase being more marked than that of RNAase. Paper chromatographic analysis of the products revealed that the effect of nucleases on the distribution of C^{14} was most remarkable in the case of nucleotides and sucrose; while the nucleotides recorded an appreciable increase, activity in sugars decreased considerably. Aspartate and glutamate however incorporated more of the C^{14} than the control. It appears that the relative dstribution of C^{14} into the 'true' photosynthetic products e.g. sucrose and in the Krebs cycle acids and related compounds are affected by treatment with nucleases.

When the algal cells were incubated with $Na_2HP^{32}O_4$ for 75 sec. followed by Barium fractionation and chromatography it was observed that the P^{32} incorporation into the adenine nucleotides was not affected by nuclease treatment. This might be interpreted to indicate that the phosphorylation step in photosynthesis is unaffected even though the CO_2 fixation reactions are.

107. Diurnal and Nocturnal changes undergone by chloroplasts in Motor cells of *mosa pudica* Linn.

MRIDULA DATTA and ASHOK CHATTERJEE, Calcutta.

In the cortical cells of the pulvinus of the sensitive plant *Mimosa pudica* Linn., chloroplasts are absent. There occur in these cells numerous small oval to elongate moving bodies, the nature of which have not been fully explained in literature. These bodies appear to be linked with chloroplast formation which again is related to loss of motility by the cell. This latter occurs in various ways, viz., (1) When the plant is placed in the dark (2) When leaves in the field grow senile, and, (3) the pulvini of plants with lesser degrees of motility viz. *Mimosa pudica*, *Averrhoa carambola*. In these cases, the bodies gradually group together which then merge into larger bodies, each of which in time develops into a regular chloroplast, giving the grara test with Strugger's Rhodamine B method. When dark treated plants with regular chloroplasts are placed in the light, there occurs a gradual breakdown of the complex chloroplast structure and once more the small free particulate bodies appear in the cytoplater. These bodies undergo modifications every evening with the onset of darkness, but do not overnight change into complete chloroplasts as the latter stage takes at least 36 hours to be reached. Present indications are that these changes may possibly be tied up with the varying sugar content of the cell.

108. Auxin-induced metabolic changes in the potato tuber.

ARCHANA NIYOGI and S. P. SEN, Calcutta.

In a previous paper (Sen & Niyogi, Pl. Physiol. Suppl. 33 : iii, 1958) the relatonship between CO_2 fixation and auxin action in *Avena* Coleoptile and root-tissues has been described. The present paper is concerned wih auxin-induced metabolic changes in the potato tuber durng the lag phase of water uptake.

When potato discs (5 mm. diam × 0·5-1·0 mm. thick) were incubated with $Na_2HP^{32}O_4$ in phosphate buffer of pH 6·0 with different concentrations of NAA at 30°C, the curve for phosphate absorption was found to be similar to the two phase concentration curve usually encountered in auxin-induced growth. Low concencentrations of the auxin stimulated the incorporation of P^{32} into the alcohol-insoluble fraction, but activity in the alcohol-soluble fraction decreased. Similar results were also observed with IAA. Replacement of the auxin by DPNH or DPN however enhanced P^{32} incorporation in the alcohol-soluble fraction. Paper chromatographic analysis of the soluble fraction revealed the presence of P^{32} in at least 6 different compounds but high concentrations of the order of 5×10^{-3} M markedly decreased the number of compounds. At 5°C also the same picture was observed, the most remarkable change being that with 5×10^{-3} M NAA 98% of the radioactivity was located in a compound with Rf values of 0·36 and 0·33 in phenol-water and butanol-acetic acid-water respectively.

CO_2 fixation studies empoying $NaHC^{14}O_3$ also indicated an inhibitory effect of auxin on the C^{14}-incorporation in the alcohol-soluble fraction. In the cell-wall components of the alcohol-insoluble fraction, C^{14}-incorporation in the pectate and polysaccharide fractions was stimulated by low concentrations of IAA, but not in the protopectin or the polyuronide hemicellulose fractions. When auxin was substituted by DPNH or DPN, sharp stimulations were observed except in the case of polysaccharides, where the promotion observed was slight, if at all.

109. The relationship between Auxins and Nucleic acid synthesis in Coleoptile tissues.

B. B. BISWAS and S. P. SEN, Calcutta.

The effect of indole acetic acid on the synthesis of nucleic acids in oat and rice coleoptiles has been investigated.

Subapical sections of *Avena* coleoptiles were incubatd with $Na_2 HP^{32}O_4$ at pH 6·0 with the following concentrations of indole acetic acid (IAA) : 10^{-3}M, 10^{-6}M and 10^{-9}M. After two hours the coleoptiles were killed with cold trichloroacetic acid and the nucletic acids fractionated. A significant increase in the P^{32} incorporation was observed in boh DNA and RNA with low concentrations of IAA. Similar results were also obtained with rice coleoptiles.

To study the incorporation of C^{14} into the nucleic acids Avena coleoptiles were incubated with acetate-1-C^{14}, acetate-2-C^{14}, $NaHC^{14}O_3$, Na-formate-C^{14} and glycine-1-C^{14} with 10^{-6}M IAA and without. It was observed that C^{14} incorporation into the nucleic acids was practically unaffected except that some stimulation of C^{14} incorporation into RNA was observed with glycine. The effect of auxins on nucleic acid synthesis would thus appear to be exercised through its effect on nucleotide synthesis rather than the reactions leading to the synthesis of the purine and pyrimidine bases or the sugar moieties.

110. Effects of sugars on the development of protonema and bud formation in *Pohlia nutans*.

G. C. MITRA, Delhi.

The effects of various concentrations of sucrose and glucose as well as of mannitol alone and in combination with glucose, on the development of protonema and bud formation in *Pohlia nutans* were investigated in sterile culture under controlled conditions of light and temperature. Half-strength Knop's solution with a drop Berthelot's mixture to each 100 c.c. of the solution was used as the basic medium.

The best protonemal growth was obtained in 1 per cent glucose or sucrose. In the protonemal filaments from cultures containing high concentrations of glucose, mannitol or mannitol *plus* glucose there was a marked decrease in cell length although a noticeable increase in cell wall thickness was not observed. The protonemal filaments of these cultures showed characteristic nutation patterns.

Other effects are : (a) at the lower concentrations of the two sugars, the observed effects on bud formation were of a quantitative rather than a qualitative nature; (b) the two sugars inhibited bud formation at higher concentrations and even their lower concentrations became inhibitory at later stages of protonemal growth; (c) with increasing sugar concentrations there was a progressive shortening of the axis of the leafy plants with reduction in internode length and in leaf size; (d) the above effects were more marked in glucose than in sucrose cultures and were also produced in cultures containing mannitol; and (e) comparison of the effects of glucose, sucrose, mannitol and mannitol *plus* glucose indicated that the morphological peculiarities and the inhibitory effects observed in the higher concentrations of each sugar may not be due to the concentrations of the sugars as such, but, at least in part, to the associated increase in osmotic value.

111. Effect of Water Extract of Stigma, Style and Ovary of Madonna Lily and of Amino-acids Cystine, Arginine and Glutamic acid on Growth Elongation of Pollen Tubes.

B. SEN and GYANENDRA VERMA, Almora.

One in 10 water extracts of fresh stigma, style and ovary of Madonna lily were made, and the effects of incorporating their optimum dilutions in 12 5% sucrose solution, on the growth elongation of Madonna lily pollen tubes were observed. The optimum dilutions, which gave maximum elongation of pollen tubes were found to be: Stigma extract 1/50; style extract 1/200; ovary extract 1/200. The comparative lengths of pollen tubes, induced in 5 hours by these optimum concentrations were: Control, 1278 μ, stigma extract, 1432 μ; style extract, 1578 μ; ovary extract, 1670 μ.

Optimum micro-concentrations of amino-acids 1-cystine, 1-arginine (monohydrochloride) and 1-(+) glutamic acid were found to be 50 p p.m., 0·025 p.p.m. and 0 025 p.p.m., respectively. Compared to the length in control medium (12·5% sucrose) of 440 μ, the lengths after 5 hours' culture at room temperature of pollen tubes in media with cystine was 728 μ, with arginine, 894 μ and with glutamic acid, 1256 μ.

These experiments were carried out in connection with the Scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, new Delhi.

112. Effect of Different Sugars on the Pollen Tube Growth of Madonna Lily *(Lilium Candidum)*.

B. SEN and GYANENDRA VERMA, Almora.

With a view to develop media for growing pollen grains simulating the natural medium, the contents of different sugars in fresh stigma, style and ovary of Madonna lily were determined by the chromatographic technique. Their chromatograms showed 4 spots corresponding to (i) sucrose, (ii) glucose and galactose, (iii) levulose and sorbose and (iv) arabinose. From the areas of the spots the concentration of sugars appeared to be maximum in stigma and minimum in ovary.

Preliminary experiments were carried out to determine optimum concentrations of glucose, galactose, levulose, sorbose and arabinose, which induced maximum elongation of Madonna lily pollen tubes. Compared to length of pollen tubes after 5 hours' growth in 12 5% sucrose of 1480 microns, the lengths in 7% glucose were 874 microns, in 6% galactose 794 micron, in 5% levulose 594 microns, in 5% sorbose 628 microns and in 5% arabinose 450 microns.

After trying the different concentrations of the hexoses found in the pistil, two suitable mixtures, (a) sorbose 0·83% + levulose 0 83% + galactose 1% and glucose 4% (b) sorbose 23% + levulose 1% + glucose 4%, were found to induce increased growth of Madonna lily pollen tubes, being 1930 microns and 2262 microns respectvely, as compared to 1196 microns in 12·5% sucrose in 5 hours.

These studies were carried out in connection with the scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

113. Studies in the Pollen of Crop Plants—Wheat (*Triticum vulgare*, Linn). I.

B. SEN and GYANENDRA VERMA, Almora.

Wheat pollen is very difficult to grow in artificial media. Very few of the pollen grains are viable and they remain so for only a very short time. No suitable liquid media could be developed for their germination. Satisfactory germination of wheat pollen grains was obtained in sugar-agar media, containing 1% agar in 12·5% to 22·5% pure sucrose solutions. The pollen grains germinate as soon as they come in contact with the germinating medium and within 3-4 minutes they begin to burst. The germination of wheat pollen was, therefore, observed as soon as the grains were dusted on the media.

Different sugar-agar media were found to induce growth elongation of pollen tubes of the 19 strains of wheat tried, from 20 to 240 microns. Different strains of wheat pollen required diffrent concentrations of sucrose in the germinating medium for their optimum germination and growth elongation. Also, the maximum lengths attained by the pollen tubes were found to vary with the strain. However, the vegetative phases of different strains of wheat could not be correlated with the optimum concentrations of sucrose in the media required by their pollen grains for optimum germination and growth of pollen tubes, nor with the lengths of their tubes.

Pollen tubes of wheat C.I. 3669/17 were found to last much longer without bursting. Incorporation of 10 p.p.m. boron (as boric acid) in the germinating medium induced the average tube growth of 414 microns, as compared to 90 microns in the control medium (17·5% sucrose+1% agar).

These investigations were carried out in connection with the scheme of Plant Physiology and Cytology, financed by the Indian Council of Agricultural Research, New Delhi.

114. Auxin control of secondary growth in the petioles of herbaceous dicot leaves.

B. SAMANTARAI and T. KABI, Cuttack.

For studying the factors concerned in the secondary growth petioles of *Ipomoea batatas* were chosen as these do not produce secondary growth when attached to the plant, but produce copious secondary growth when isolated and treated with synthetic auxins. The leaves which formed experimental material were divided into three categories viz., (1) isolated, (2) attached and (3) girdled above and below the node. These groups of leaves were treated with synthetic auxins like β-indolyl butyric acid (IBA), β-indolyl acetic acid (IAA) and α-Naphthyl acetic acid (NAA) and auxin antagonisers like Maleic hydrazide (MH), Phenyl Mercuric Nitrate (PMN) and 2, 4-dichloranisole (DCA). Food material like sugar and asparagine and certain 'B' vitamins were also administered. All these substances at different concentrations and alone or in combinaton were administered to these three groups of leaves. It as found out that (1) Auxin administration enhanced secondary growth. (2) Girdling alone produced secondary growth whereas ungirdled leaves had no secondary growth. (3) Auxin antagonisers either partially or completely inhibited secondary growth. (4) Food material and 'B' vitamins did not produce any effect on secondary growth and (5) The effect of auxin was to activate or initiate cambium which gave rise to the secondary growth.

Therefore it is suggested that secondary growth is chiefly brought about by the auxins which may be native or synthetic and the course of secondary growth is through the formation of cambium.

115. Treatment of Cuttings with Hormones and other Chemicals.

S. K. CHATTERJEE, Darjeeling.

The present investigation was carried out to establish the effects of two synthetic hormones—Indole butyric and Indole acetic acids on the rooting responses of Chrysanthemum (*C. coronarium*, L.) cuttings. In addition, the effects of some essential elements (Calcium, Iron, Magnesium, Potassium and Phosphorus) on induction of roots in cuttings were followed. Treatments included the application of hormones directly and in addition to normal nutrient and differennt substitution solutions. Another set of treatments was made where only the normal nutrient solution and different substitution solutions were applied to the cuttings.

Results show that the elements Calcium, Magnesium, Iron, Phosphorus and Potassium are needed for the production of roots. Cuttings responded least to Magnesium and Calcium defiencies where rooting intensities were extremely poor. Different nutrient solutions where Iron, Potassium and Phosphorus were respectively omitted showed retarding effects on the rooting behaviour of cuttings. The effects of hormones Indole Butyric and Indole Acetic acids on increasing the intensity of rooting of cuttings are also clear. Of the two hormones, IBA seemed to be more effective in the concentration used. The addtion of hormones to the normal nutrient solution and to each of the substitution solutions enhance the rooting response of the cuttings.

It is suggested that the external supply of all the elements (Ca, Mg, Fe, K, P) is needed to promote the production of roots. The exclusion of any one of the elements may be supposed to disturb the nutritional status of the cuttings which require to be optimal for the rooting of the untreated controls. Furthermore the presence of some internal growth-substances of the hormone is necessary for the formation of roots in cuttings. Thus it may be stated that a complex of internal factors whether nutritional, hormonal or both limit the rooting response of cuttings. And a growth-regulating system involving a mutual inter-action of different mineral elements (Ca, Mg, Fe, K, P) and an internal auxin type factors regulates the initiation and formation of roots.

116 Inhibitory effect of MH, PMN, and DCA on the rooting response of isolated leaves.

B. SAMANTARAI and T. KABI, Cuttack.

Emergence of roots has been inhibited in the isolated leaves of *Ipomoea batatas*, *Tridax procumbens* and *Boerhavia diffusa* by the application of synthetic growth substances such as maleic hydrazide (MH), Phenyl Mercuric Nitrate (PMN) and 2, 4-dichloranisole (DCA) The petioles of the isolated leaves were dipped in aqueous solutions of 200, 100, 50, 20, 10, 5 and 2·5 ppm. of the substance. The final rooting response was measured by the percentage of leaves rooted, the average days from treatment to first root emergence, average number of roots per leaf and the fresh weight of the roots produced. In all the leaves MH and DCA at higher concentrations like 100 and 200 ppm. completely stopped emergence of roots, whereas at lower concentrations like 2·5 and 5 ppm. marked inhibitory effect was not found. PMN proved to be highly toxic at higher concentrations like 200 and 100 ppm. The petioles of all the leaves treated with these concentrations rotted away. Root emergence was completely stopped by PMN at a concentration of 10 ppm. and even at lower concentrations like 2.5 and 5 ppm. root emergence was delayed than the control.

117. Effect of certain auxin-antagonisers on the rooting response of some stem cuttings with distinctive anatomy.

B. SAMANTARAI and H. PATTNAIK, Cuttack.

Stem cuttings of *Argyreia speciosa* Sweet, were treated with aqueous solutions of β-indolyl butyric acid (IBA), Maleic hydrazide (MH), Tri iodo-benzoic acid (TIBA), 2, 4-dichloranisole (DCA), IBA+MH, IBA+TIBA and IBA+DCA. The concentration of IBA was 100 ppm as it was found to be optimal concentration for rooting response for these twigs. The concentration of MH, TIBA and DCA applied were 100, 50 and 20 ppm. Controls were kept in water. The treatments lasted for 24 hours and subsequently washed and cultured in tap water under humid conditions under diffused light in propagating chambers.

It was found out that the cuttings treated with IBA produced copious roots whereas those treated with MH, TIBA and DCA had no roots at all. However cuttings treated with IBA and subsequently with MH, TIBA and DCA produced some roots at lower concentrations of these auxin-antagonisers. It is suggested that auxin-antagonisers themselves stop the conversion of mature cells to meristematic ones and also stop the organisation of root primordia for cuttings pretreated with IBA and subsequently treated with auxin-antagonisers do produce some roots.

118. Effect of plant growth substances on the germination and growth of rice seedlings.

G. MISRA and G. SAHU, Cuttack.

The effects of three plant growth substances, β-indolylacetic acid (IAA), α-naphthylacetic acid (NAA) and 2, 3, 5-triiodobenzoic acid (TIBA), were studied on the germination and growth of seedlings of three different varieties of rice, N.^{136} (early), T. ^{1145} (early-winter) and T. ^{141} (mid-winter). The treatment consisted of soaking the seeds for 72 hours in the aqueous solution of each of these plant growth substances at the concentrations of 500, 250 and 100 parts per million (ppm). NAA at 250 and 500 ppm and TIBA at 500 ppm markedly depressed the germination of all these three varieties. These two chemicals at the other concentrations, as well as IAA at all concentrations did not produce any significant change in germination percentage in comparison with the controls. The depressing effect was maximum in the early variety with a slightly smaller value in the early-winter variety and the least in the mid-winter variety. The growth of the radicle and the plumule were affected by the three plant growth substances in a manner almost parallel in all the varieties. The emergence of the radicle was completely suppressed in the three varieties by NAA at all concentrations. The plumules emerged from the seedlings treated with NAA were much thicker than those treated with other chemicals. These three plant growth substances at the concentrations used produced in general a repressing effect on the elongation of both the radicle and the plumule and on their fresh weight in comparison with those of the untreated controls

119. Influence of IAA and NAA on growth and tuber development in potato plant.

B. D. BAIJAL and I. M. RAO, Agra.

In order to asses the influence of two synthetic phytohormones on growth and yield of potato plant, a sand-culture experiment in pots was conducted in the rabi season of 1956-57. Seed-potatoes (Phulwa variety) of uniform size with about same number of 'eyes' were sown in the pots (one tuber per pot) on 8th November. Knop's solution was added daily to the pots. IAA (β-Indolyl acetic acid) and NAA (α-Naphthalene acetic acid) were supplied at 5 p.p.m. to the plants in the culture solution daily from the time of sowing. Supply of NAA was stopped from 17th December as it retarded the growth. IAA-supply was continued till the end of December but on alternate days. After harvesting the plants on 27th March, 1957, observations were noted for the over-dry-weight of roots and number and weight of tubers formed on each plant. As five replications were maintained for each treatment, the results were analysed statistically. After NAA supply was stopped, the plants recovered though not completely. Yield of tubers was lowered by about 26% as compared to the control; number of tubers as well as the weight of 100 potatoes were also lower than the control, the root dry-weight was not affected.

Plants with IAA supply showed better growth than the control, the increase in root-weight being more than three times than that of the control. A small increase in yield of tubers of about 12% was also noted with IAA, while the number of tubers and 100-tuber-weight were not affected.

The results clearly show that NAA is a more 'active' hormone than IAA Although growth was improved by IAA, the increase in the yield was small as the number of tubers and the 100-tuber-weight were not altered by IAA. It is suggested that in its relation to auxin, the basic physiological mechanism for tuber development may be similar to that of the flowering phenomenon, although the former is a part of the vegetative phase, the object of the two, leaving aside the genetical aspect is the same.

120. Influence of presowing seed-treatment with 2, 4-D on Seedling growth of Maize T. 41.

S. K. SINHA, KANPUR, and I. M. RAO, Agra.

Pretreatment of seeds with low concentrations of 2, 4-D was found beneficial to growth and maturity of wheat (Bhardwaj and Rao). In order to assess the influence of 2, 4-D on Maize, in detail, investigations were carried out on the effect of presowing soaking of Maize seeds in solutions of 0, 0·1, 1, 10, and 100 ppm. of 2, 4-D on (i) seedling respiration (O_2-uptake), (ii) seedling growth and (iii) growth and maturity. The present paper deals with the second aspect.

Following the modified Garrard's technique, the pretreated seeds were 'sown' between the filter-paper roll, inserted in a test tube and the glass wall. The filter paper roll was kept moist by distilled water at the bottom of the tube. The tubes were kept at about 30°C in darkness except during measurements of root and plumule length. Observations were noted daily up to 96 hours from the beginning of the seed-treatment. Sufficient replications were maintained and the data analysed statisticaly on Factorial basis.

The initial (i.e., at 48 hours) root-growth with 2, 4-D was directly proportional to the concentration, although with 0·1 ppm, the inhibition was less than 10%; with 100 ppm, total root-length was about 40% of the control (0-ppm). Root-growth recovered by the end of 96 hours, almost completely in 0·1 ppm set but only slightly in 100 ppm.

The initial effect on plumule-growth due to 2, 4-D was slight and was not related to the concentration; in one trial stimulation was noted with 1 in 100 ppm while there was inhibition by the other doses. In the second experiment, stimulation was noted in all the levels, nearly 240% with 10 ppm. Later on in this trial, the effect disappeared and at the end of 96 hours, root growth in 100 ppm was nearly 60% of the control while it was about 105% in 0·1 ppm. A similar tendency was noted in the first experiment too.

The results indicate that pretreatment of seeds with 2, 4-D initially inhibit root-growth which is followed by recovery. Both inhibition and recovery are related to the concentration of 2, 4-D; plumule-growth indicated a gradual increase, within the experimental period, of the inhibitive effect of 2, 4-D; the magnitude of depression at the end of 96 hours was related to concentration.

121. The action of Beta Indolyl butyric acid on the rate of growth of *Phaseolus radiatus*, L.

S. NAIK, Sambalpur.

With a view to investigate the effect of growth promoting substances on the rate of growth of *Phaseolus radiatus*. L., experiments were performed with β-Indolyl butyric acid.

Fresh seeds were treated with the hormone in watery solution at various concentrations ranging from 1 ppm. to 10 ppm. The period of soaking of the seeds was 6, 12, and 18 hours respectively at 30°C. The hormone treated seeds were sown separately in different pots containing identical soil. Weekly records for the growth in heights of different plants were taken and the mean rate of increase in height during the week was determined.

The results show that β-Indolyl butyric acid has got growth promoting effect on *Phaseolus radiatus*. L. The rate of growth is affected by the concentration of the hormone solution. As the doses are lessened the growth becomes more and more pronounced. So the lower the concentration the higher is the rate of growth. It also shows that the growth hormone is effective even in very low dilutions and probably acts as an inhibitor only in higher concentrations.

122. Effect of plant growth substances on the growth and flowering of four varieties of late-sown winter rice.

G. MISRA and G. SAHU, Cuttack.

The effects of three plant growth substances, β-indolylacetic acid (IAA), α-naphthylacetic acid (NAA) and 2, 3, 5-triiodobenzoic acid (TIBA) has been studied on the growth and flowering of four winter varieties of rice, BAM. 9 (Mypali), Co. 2. (Poombalai) Adt. 2 (White Sirumani) and Co. 25 (Hybrid). The grains were soaked on August 2, 1957 for 72 hours with 500 parts per million of each of the plant growth substances. After a thorough wash in water they were sown in seed-bed pans. When seedlings attained the age of 21 days they were transplanted into bigger sized pots and from 28th day onwards were sprayed once a week with the solution of the corresponding plant growth substances in which the grains were initially soaked. The treatment terminated with panicle emergence in each plant. All the three plant growth substances at the concentration used brought about a delay in flowering in comparison with the controls. The greatest delay was in case of plants treated with NAA and least in those treated with TIBA. With regard to the vegetative characters each of the plant growth substances lowered the production of tillers and leaves. However, their effect on height of the plants was not uniform in all varieties. Each of the plant growth substances produced an inhibiting effect on the elongation of the shoot in the two varieties, BAM. 9 and Co. 2 whereas an acceleration was brought about by TIBA in the other two varieties Adt. 2 and Co. 25 and by IAA in the variety Adt 2.

123. Differential response of Tagetes patula and Impatiens balsamina to Gibberellic acid under subtropical conditions.

S. SARKAR, Calcutta.

Seedlings of *Impatiens balsamina* and *Tagetes patula* were grown in a glass-house in Darjeeling during the summer of 1958 and their responses to external application of Gibberellic acid were studied under natural conditions of temperature and light. During the experiment the maximum day-temperature recorded was 29.5°C and the minimum night-temperature was 15°C. Gibberellic acid was applied as drops of aqueous solution (10^{-4}M GA) containing 0.01% Teepol as detergent to the apex of the main shoot at regular intervals of 3 or 4 days, over a period of nearly a month. The total amount of GA received by an individual plant was approximately 25μg.

Results show that whereas *Tagetes* plants are significantly influenced in their vegetative and reproductive characters by applied GA, *Impatiens* remains more or less unaffected. GA-treated *Tagetes* plants were nearly 106% taller than the controls, and 85% of them produced macroscopic flower-buds within 36 days from the beginning of GA-treatment, at a time when all the control plants were still strictly vegetative. In case of *Impatiens* on the other hand, growth and flowering were normal but there was no significant difference in height of the plants, nor was there any significant earliness in flowering. The only response exhibited by them were the symptoms of an incipient chlorosis of the very young leaves and a significant increase in the length of the flower-stalks. Though the flowers of the treated plants were not larger in size than those of the controls, their peduncles were about 50% longer (24 mm. as against 16 mm.). Probable causes for the poor reactivity of *Impatiens* has been discussed in the light of recent observations on differential biological properties of Gibberellin-like factors, the presence of endogenous Gibberellin-like substances and the interaction of specific inhibitory and other limiting factors.

124. In vitro experiments on apomictic *Aerva tomentosa* Forsk.

PREM MURGAI, Delhi.

In the past, considerable attention has been devoted to the physiology of fruit and seed in sexually fertile plants. That auxin controls fruit setting, and seed formation requires the stimulus of syngamy is now an established fact. Nevertheless, there are a few higher plants which produce parthenogenetic embryos. Little is, however, understood regarding the physiology of apomicts.

Aerva tomentosa is dioecious, and male plants are extremely rare in nature; nevertheless seed setting is quite normal. Since the plant is apogamic, *in vitro* experiments were taken up to determine the nutritional requirement of the seed and the fruit.

Excised ovaries (220 μ, 440 μ in diameter) and spike pieces (3-4 mm.) were reared on artificial media, and their growth studied over a period of 30 days.

In Nitsch basic medium (NB), the young ovaries (220 μ) gave 20% fruit setting. The fruits were smaller than the *in vivo* ones (660 μ : 1100 μ) and contained abortive seeds. With older ovaries (440 μ) also, the seeds were empty inside, but the fruit setting was 40%.

When the basic medium (NB) was supplemented with vitamins and glycine (NBV), the fruit growth increased to 50% and the size matched that of natural fruits (1100 μ). As in the basic medium, only seed coat developed normally. Addition of casein hydrolysate (200 ppm) to NBV resulted in smaller fruits (660-990 μ). Gibberellin (10 ppm) and IAA (2 ppm), when administered alone or in combination inhibited the growth of the ovaries and failed to produce fruits. The ovules did not form even the black seed coat.

In kinetin (0·2 ppm)+IAA (2 ppm), the growth of the ovary (330 μ) ceased after attaining a diameter of 550 μ. Also the ovules did not form black seed coats.

The spikes comprising either buds or flowers at anthesis were later planted on NBV+yeast extract (1000 ppm), NBV+casein hydrolysate (400 ppm), NBV+gibberellin (10 ppm), NBV+IAA (2 ppm), NBV+IAA (2 ppm)+gibberellin (10 ppm) and NBV+IAA (2 ppm)+kinetin (0·2 ppm). So far the best results were obtained in the yeast extract medium, whereas in the remaining media, the results were more or less comparable to those with the excised ovaries in culture. With yeast extract, the spikes at anthesis yielded 80% fruits while the buds produced 20%. Only in the former, the seeds contained a mature embryo and a few layered endosperm.

125. Some effects of Maleic Hydrazide on *Cannabis sativa* Linn.

MANASI RAM, Delhi.

The plants of *Cannabis sativa*, grown in the University Botanical Garden, were treated with 100, 500 and 1000 ppm of maleic hydrazide at the initiation of flowering period.

The first visible effect was the yellowing of leaves in the plants treated with 500 ppm. The leaves exhibited gradual malformation in both male and female plants but the effect was much more pronounced in the male plants.

At 100 ppm, the leaf segments become narrower This tendency increases with a higher dose and at 1000 ppm the leaf margin becomes smooth instead of serrate and the segments look like whips. The main lobing of the normally digitate lamina undergoes reduction or is altogether suppressed.

The most significant effects were observed on flowers when plants were treated at 1000 ppm. The male flowers exhibited bizarre forms. The perianth lobes become crumpled and unequal in size. The stamens showed a marked shrinkage in length accompanied by a curving of the apical part in the form of a hook. The pollen sacs occupied one fourth of the anther lobe, and sometimes the stamens failed to show any differentiation of the sporogenous cells.

The microspore mother cells undergo aberrant meiosis, and polyspory and the formation of pollen grains of various shapes and sizes is common.

On female plants, the flowers remain quite normal except that sometimes they become shrivelled.

After a lapse of six weeks from the date of treatment, even the male plants start producing normal flowers.

126. Response of an early rice to 2-Methylbenzimidazole.

D. MISHRA and G. MISRA, Cuttack.

Benzimidazole and its analogues have been shown to be inhibitors of growth of higher plants when applied through the roots. Seeds of an early variety of rice, N. 136 were soaked for 48 hours at the concentrations of 1, 10, 100 and 1,000 parts per million (ppm) of 2-methylbenzimidazole. After a thorough wash in water the seeds were sown in 10″ earthenware pots. The plants were then separated into two different series, Series I was left after the initial seed soaking without any further treatment, while eSries II was given in addition to a foliar spray with the corresponding concentration at weekly intervals commencing with 3-week-old plants and continued up to heading. A third set soaked in distilled water served as controls. Plants grown from seeds treated with the three concentrations 10, 100, and 1,000 ppm. showed a significant delay in flowering. The morphological characters such as number of tillers, green leaves and plant height were recorded three times at fortnightly intervals during the entire life cycle of the plants both of the control and treated sets. In all these characters the treated plants showed a depressing effect which gradually increased in intensity with the rise in the concentration of 2-methylbenzimidazole from 1 ppm. to 1,000 ppm.

127. Studies on the effects of Colchicine on growth and reproduction of an early variety rice.

D. MISHRA and G. MISRA, Cuttack.

The effects of colchicine at the concentrations of 1, 10, 100 and 1000 parts per million (ppm.) were studied on an early variety of rice, N. 136 in pot culture experiments. The treatment consisted of soaking the seeds in the various concentrations for 48 hours followed with a foliar spray with the corresponding colchicine solutions once a week begining with 28-day-old plants till panicle emergence. The plants treated with 1 and 10 ppm. showed a significant earliness in flowering by 3·38 and 2·71 days respectively. The plants treated with 100 ppm. did not show any significant change from the controls in this respect, whereas those treated with 1000 ppm. showed the reverse change of delay in flowering by 2·33 days. With regard to the morphological characters it is seen that the average growth rate as judged by the production of tillers, leaves and elongation of the shoot showed an ascendancy at the three lower concentrations whereas it is somewhat depressed at the highest concentration of 1000 ppm.

128. Control of some weeds by 2, 4-Dichlorophenoxyacetic acid.

B. PANIGRAHI, Berhampur and G. MISRA, Cuttack.

Three important weeds *Sphaeranthus indicus* L, *Heliotropium indicum* L. and *Calotropis gigantea* Br. were treated with the sodium salt of 2, 4-dichlorophenoxyacetic acid (2, 4-D) at the concentrations of 1%, 0·5%, 0·25%, 0·1% and 0·05%. 2, 4-D at the higher concentrations put an immediate check on the growth of the plants and in addition set up a retarding process which culminated sooner or later in the death of the plants. The immediate effects of the application of the chemical were that the leaves dropped down, became yellowish, showed various types of curlings and foldings and drying set in. The vegetative shoots bent down with the treatment. After the spraying with the chemical no flower bud bloomed nor any inflorescence appeared. The development of fruits and seeds was completely arrested and as such, by the application of the chemical, the race of the plant can be made to extinguish from a particular region thereby the possibility of the same plant to grow again in the next season in the same locality will be fully eliminated. With regard to the comparative effect of the different concentrations it was observed that the lowest concentration had similar inhibitory effects as those of the highest concentration with the only difference that the time lapse for complete death was very much shortened in case of the highest concentration.

129. Response of Argemone mexicana to the treatment of 2, 4-Dichlorophenoxy-acetic acid and Maleic Hydrazide.

B. PANIGRAHI, Berhampur and G. MISRA, Cuttack.

The comparative effects of 2, 4-dichlorophenoxy acetic acid (2, 4-D) and Maleic Hydrazide (MH-40) on eradicating the obnoxious weed *Argemone mexicana* has been studied. Five different concentrations 1%, 0·5%, 0·25%, 0·1% and 0·05% of each of the chemicals was tried. Three different methods of application, namely, spraying the chemical on the foliage leaves, introducing the chemical into the plants through injection and feeding the plants with the chemical through cut leaf tips were adopted. Of the two chemicals used for the control of this particular weed it was found that even the lowest percentage of 2, 4-D was effective enough to kill the plants. There was rapid deterioration in all the vegetative characters of the plants and ultimately the weeds were so completely killed that they did not leave behind any seed for propagation of the race in the coming season. MH 40 was also an effective drug but it took comparatively a long time to kill the plants. In both the chemicals at all the concentrations tried there was complete inhibition of growth and reproduction. Flowers did not bloom nor the fruits set. Hence both 2, 4-D and MH-40 can successfully be applied for eradicating this weed. Of the three methods tried feeding the chemical through cut leaf tips and internal application through injection proved better than the external foliar spray.

130. Studies in the germination of Seed of *Corton Sparsiflorusm.*

V. N. KAUL, Baranasi.

Seeds of *Croton Sparsiflorus* M Collected in December, 1955 and set for germination showed dormancy due to testa. This could be cut short by weakening the hard seed coat by such treatments as scarification, stratification, burial under mud, etc.

The seeds are not much light sensitive in germination as it takes place both in light and darkness, although the latter promotes the rate and percentage of germination. pH values below 3·5 and above 8 are greatly inhibitive to germination and seedling development, the optimum lying between pH 6 to 7·5.

Optimum temperature for germination ranges between 15-30°C. Diurnal fluctuations of temperature, such as 32-7°C, 29-10°C, 35-13°C, 44-17°C, 46-24°C, 33-26°C, accelerated germination. It did not take place at constant temperatures of 5-7 and 35-40°C, except when these were alternated with brief periods of 15-25°C. However, the seeds show a small percentage of germination at 10°C. Fluctuating temperatures are, therefore, highly conducive to germination, and particularly fluctuations down to 15 to 9°C. Soil and sunlight also promote germination to a limited extent.

The seeds on immersion in water get surrounded by a mucilaginous sheath within 15 to 30 minutes, derived from the cells of testa. It is advantageous in retaining moisture and in cementing the seed to the substratum, which facilitates the penetration of the radicle into the soil. Further, it may form a substrate for growth of fungi, which may help in splitting open the hard seed coat. However, in absence of the favourable conditions for germination, the endosperm and the embryo may decay.

131. Effect of coumarin on the germination and growth of rice seedlings.

S. N. PATNAIK and G. MISRA, Cuttack.

The effect of coumarin (the lactone of o-hydroxycis-cinnamic acid) on the germination and growth of the seedlings of a variety of early rice, N. 136 has been studied. Graded seeds were soaked for 72 hours in different concentrations 1, 10, 100 and 1000 parts per million (ppm.) of coumarin. The seeds thus treated were thoroughly washed with distilled water and were allowed to grow on moist filter paper in petri dishes kept in a dark chamber at room temperature. One set soaked in distilled water was maintained as control. There were three replications for each treatment. Records on the length of the longest root, length of shoot, number of branch roots, fresh weight of all the roots and that of the shoot per seedling were taken every fifth day commencing with 5-day-old seedlings. The results indicated four distinct influences of coumarin on the germination and growth of rice seedlings. Firstly, germination was completely inhibited at the highest concentration of 1000 ppm. and it was almost normal in the other three lower concentrations. Secondly judged by linear elongation as well as by fresh weight there was a marked promotion in the growth of root and shoot in the lower concentration of 1 ppm. which was followed with a significant gradual depression at the two higher concentrations of 10 and 100 ppm. Thirdly, the depressing effect at the concentration of 100 ppm. was maximum with the youngest seedlings and this effect rapidly diminished with increase in the age of the seedlings. Fourthly, in any particular high concentration the growth of the roots were proportionately much more inhibited than the growth of the shoots.

132. Germination Inhibitor in Tomato Juice.

A S DUBEY, Patna.

Investigation on the effect of tomato juice on the germination capacity of various seeds like wheat, rice, gram, mung and mustard have been undertaken. The sterilised seeds were soaked for different periods in the tomato juice extracted from the freshly plucked fully ripened fruits. After the requisite period of soaking they were washed thoroughly in running tap water and then in the distilled water. Another set of seeds were likewise soaked in distilled water for the different periods as in the treated sets and allowed to germinate in water soaked filter paper kept in petridishes to serve as controls. It was observed that the seeds do not germinate in the tomato juice when soaked for 24 hours or longer periods whereas in the control sets almost cent per cent germination was observed on the 5th. day. When the seeds are soaked for 12 hours only a very negligible percentage of germination was noticed. The seeds, in tomato juice, when kept for longer periods, turned black and became wrinkled.

The inhibition of germnaton of the different seeds tested is ascribed to the presence of a probable germination inhibitor substance in the fruit juice of tomato which in higher doses is very toxic to the seeds. The nature of the substance whether an antiauxin or some chemical germination inhibiting substance can not be established now.

133. Tracer studies on the Biochemical Aspects of flowering. V. CO_2 fixation and acetate-metabolism in *Rupsail* Rice.

S. P. SEN, Calcutta.

In continuation of previous experiments on the metabolic changes induced by photoperiodic treatments, CO_2 fixation and acetate metabolism in the short day plant *Rupsail* rice has been studied. When sown in summer months 100% flowering of the main shoot is obtained with 4 weeks short day treatment and the effect of the photoperiod on the shoot apex is quantitative.

Three week-old seedlings were subjected to 8 hr. photoperiods (in 24 hr. cycles) for 1, 2, 3 and 4 weeks. Groups of seedlings from each set were exposed to $C^{14}O_2$ in light for 15 min. The plants were then divided into four batches: one set was extracted immediately with hot 80% ethanol; a second set was exposed to darkness for 6 hrs; in the third set the 6 hr. dark treatment was followed by ½ hr. red light and in the fourth the dark treatment was terminated by extraction with hot 80% ethanol. Examination of the alcohol-soluble fraction indicated a marked decrease of C^{14} activity during the 6 hr. dark treatment in non-induced or partially induced plants. With 3 or 4 weeks induction treatment an increase was observed. This effect of dark treatment could be reversed with ½ hr. of red light. Continuation of the dark period to 16 hrs. resulted in a sharp increase of C^{14} activity in the alcohol-soluble fraction in induced plants.

Intact rice plants were also allowed to metabolise $C^{14}O_2$ in light on the 9th day of the photoperiodic treatment and the treatment continued till the end of the 3rd week when the floral primordia just began to be initiated. It was observed that the shoot apices and roots of induced plants had five and three times the the C^{14} activity in the respective organs of non-induced plants. The acetate metabolism of the shoot apices of induced plants however were not activated as compared to non-induced ones.

134. Variation in the Amino-acid Contents of the Testa, Cotyledons and Embryos of Vernalised and Untreated Seeds of Mustard, T. 102.

B. SEN and D. K. VERMA, Almora.

In an earlier communication (1958) amino-acid contents of vernalised and untreated seeds of mustard T. 102 were reported. Experiments were undertaken to find out the variation of amino-acid concentrations in the testa, cotyledons and embryos of vernalised and untreated seeds of mustard T. 102 by the descending paper chromatography technique (Consden *et al,* 1944). Butanol, acetic acid and water (40 :10 :50) were used as solvent (Giri, 1952) and 0.4% solution of ninhydrin in 95% acetone as colour reagent. Water extracts of testa, cotyledons and embryos of untreated and vernalised seeds of mustard T. 102 were prepared following the technique of Richard, Raymond and Gunter (1952).

Ten spots developed in the chromatograms representing seventeen different amino-acids or their combinations. From the measurements of areas of these spots it was found that (i) compared to the contents in testa, the concentrations of amino-acids were higher in cotyledons and embryos, both in control and vernalised seeds, (ii) both in control and vernalised seeds the number of amino-acids present in cotyledons is the highest and in the testa lowest, (iii) compared to control samples the number of amino-acids was greater in case of different portions of vernalised seeds, and (iv) Proline was present only in vernalised seeds which confirms the earlier finding (Sen and Verma, 1958) that proline is present only in the vernalised mustard seeds.

These investigations were undertaken in connection with the scheme of Plant Physiology and Cytology being financed by the Indian Council of Agricultural Research, New Delhi.

135. Variation in the Amino-acid Contents of Different Leaves of Control and Vernalised Plants of Mustard T. 102.

B. SEN and D. K. VERMA, Almora.

Experiments have been carried out to determine the concentration of amino-acids in the successive leaves of mustard T. 102 plants raised both from untreated as well as vernalised seeds by the descending paper chromatography technique, Twenty-two spots of water extracts of leaves (eleven each from control and vernalised plants), were spotted on the same sheet.

Fourteen spots representing nineteen different amino-acids or their combinations developed in the chromatograms. From the measurement of areas of these spots it was found that Cystine was present in the third up to the ninth leaf in control and from the fourth to ninth in the vernalised leaves, and its contents were generally higher in the vernalised sample. Lysine-Histidine were present in all the leaves and their concentrations were, in general, higher in the vernalised samples. Citrulline-Arginine-Glycine spots were merged together up to the fifth leaf and except in the first leaf their areas were higher in the vernalised leaves. From the sixth leaf onwards three distinct spots for these amino-acids emerged. The areas of Citrulline and Glycine were in general higher in the vernalised samples while the concentration of Arginine was greater in the control samples except in the beginning. Aspartic acid-Glutamic acid-Threonine spots were in general larger in the control samples. Alpha and Beta-alanines were not found in the third, fourth and fifth leaves of control samples, but they represented in the sixth leaf. Except in the first leaf, their contents were higher in the vernalised samples. Amino-n-butyric acid and Tyrosine spots, except in case of first and second leaves, were larger in the vernalised samples. They were present only in the first eight leaves of both control and vernalised samples. Methionine-Valine-Tryptophane spots, except in the first leaf, were, in general, larger in the vernalised samples and as also the spots of Phenylalanine-Isoleusine-Leusine.

The results show that the concentration of amino-acids is, in general, greater in the leaves of plants raised from vernalised seeds.

Further work is in progress.

These investigations have been carried out in connection with the scheme of Plant Physiology and Cytology, being financed by the Indian Council of Agricultural Research, New Delhi.

136. Certain morphological changes in *Phaseolus radiatus* L. resulting from treatment of seeds with low temperature and growth regulators.

S. C. CHAKRAVARTI, Rewa.

Present piece of investigation aims to make a comparative study of the effects of vernalization and presowing soaking treatment of seeds of *Phaseolus radiatus* L., strain N. P. 36 with water, aqueous solution of IAA, IBA, NAA, 2, 4-D, GA and TIBA in the concentrations of 100, 25 and 1 ppm. and with half divided cocoanut milk and yeast extract on the hypocotyl length and area of the cotyledonary leaves.

With the exception of GA and yeast extract, all the other treatments bring about a significant decrease in the size of the organs referred above. Similarity in the action of chilling and growth regulators reveals that during treatment of seeds and subsequent development of seedlings certain common metabolic changes take place in them.

137. Photoperiodic response of a winter variety of rice of Tripura.

T. R. DUTTA, Agartala, and G. MISRA, Cuttack.

The response of the variety *Salchikan*, a widely cultivated winter rice of Tripura, to 8 hour short photoperiod (8 A.M. to 4 P.M.) has been studied in pot culture experiments. The seeds after a preliminary selection for uniformity and sterilisation were sown in earthenware pots. After the seedlings attained 7 days they were divided into 10 sets of 6 pots each. One set was kept as control under the normal day length. The rest 9 sets were given the 8 hour short-day treatment at different ages of 10, 20, 30, 40, 50, 60, 70, 80 and 90 days for a period of one month in each set. After the photoperiodic treatment for the requisite number of days each experimental set was returned to the normal day length in the botanical garden till the time of harvest. The short photoperiods induced a conspicuous earliness in ear emergence in all the sets. The maximum earliness was in the set which received the short days at the youngest age of ten days. The degree of earliness gradually decreased with advance in the age of the plants at the time of treatment initiation. The grain yield was markedly low in the three sets which received the treatment at the ages of 30, 40 and 50 days. The low yield was due to poor setting and high percentage of sterility in the treated plants. In all the other sets the grain yield was higher than the controls mainly due to a larger number of panicles formed per plant and to greater number of grains per panicle.

138. The effect of X-Ray Dosage on Emergence of Seedlings in Rice.

AMAL KUMAR BASU, Calcutta.

The effect of X-ray dosages on emergence of seedlings in rice *Oryza sativa* L. Var. *Rupsail* (a pure line winter variety) was studied. The kernels in the dry state were irradiated with 6000, 12000, 18000, 24000 and 30000r X-rays. After irradiation they were sown in a small plot of land along with the control. A replicated design was adopted to study the effect of treatments on the emergence of seedlings. The number of seedlings emerged in each treatment were counted after 14 days of sowing. The percentage of emergence was seen to fall with increase in dosage, the emergence in 30,000r being nil. After analysing the data statistically it was observed that the differences in percentages of emergence between the control and the various X-ray doses excepting the 6,000r treatment, were significant. An attempt was made to find out an expected relationship between doses X-Rays and the emergence of seedlings.

139. Studies in the Physiology of Fruits and Vegetables. VI—Further Observation in Ripening Mangoes (Var. *Fazli*) during Storage in Normal and Low Temperature.

J. K. CHOUDHURY and D. K. DAS GUPTA, Calcutta.

While studying the keeping quality and chemical changes of *Fazli* mangoes picked at various stages of development and stored in normal and low temperatures, it was observed that the marketable qualities developed only in the mature fruits when they were stored at a relatively higher temperature (Ind. Sc. Cong. Abst. Pt. III, p. 265, 1957). Subsequently a closer examination was made of the green mature fruits gathered from the whole-sale market at Calcutta and stored at room temperatures (84°—90° F.R.H. 59—96%) and 60°—62° F (R.H. 70—75%) and some of the results obtained are given below :

Mangoes could be stored in marketable condition for 7—8 days in normal temperature and for 14 days in 60°—62°F. The losses in weight of the fruits during storage, respectively, were 12·44% and 11·37% of the initial fresh weights.

The pulp-peel ratio of the fruits increased in both the temperatures from 9·28 to 10·51 and to 10·60, respectively.

The pH increased from 3·5 to 5·0 in room temperature and to 4·4 in 60°—62°F. The total acid (as = —c.c. (N) NaoH) present in 100 gm pulp decreased from [illegible] c.c. to 2·66 c.c. and to 5·48 c.c. respectively.

Vitamin C (Ascorbic acid) decreased from 70·30 mgm./100 gm. of pulp to 34·57 mgm. and to 63·37 mgm. in normal and low temperature, respectively.

2, 4. 5-T (Trichlorophenoxyacetic acid, 500 p.p.m. and 1,000 p.p.m.) in normal temperature did not prolong the storage life of the fruits, but they were better preserved (e.g. more turgid to touch) and developed all other normal qualities.

Estimations of sugars, alcohol-soluble and insoluble matter etc. are in progress.

140. Effect of NAA and MH-30 on sprouting of non-dorment potatoes.

B. D. BAIJAL and I. M. RAO, Agra.

With rapid increase, since about a decade, in the area under potato crop in the plains, problems relating to storage of potatoes are gaining importance. Sprouting of potatoes under storage is one of the main causes for loss in quality and quantity. Although cold-storage minimises the after causes, that is microbial rotting of potatoes, it does not completely check the sprouting; further, cold-sorage facilities are as yet available for only a fraction of the potato, harvested in the plains. Once the dormancy period is ever poatoes begin to sprout and the activity is conditioned by the environmental conditions. Thus the problem resolves itself in two aspects (i) to increase the dormancy, (ii) to check further sprouting and sprout-growth in non-dormant potatoes.

In the present investigation, influence of NAA (100 p.p.m.) and MH-30 (Maleic Hydrazide, 2500 p.p.m.) on sprouting, loss in weight and percentage shrinkage in two varieties of potatoes (Phulwa and Military Special) have been studied for a period of one month at room temperature (80°F-85°F) and in the refrigerator at about 59°F. The pretreatment of the tubers involved a soaking of unsprouted tubers in the test solutions (half immersed) for 24 hours; unsoaked tubers served as control. Observations were recorded one month after the soaking treatment.

Differences due to 'treatment' and also due to 'variety' are observed. Presoaking in NAA or in MH-30 or even in distilled water in variety Military Special led to increases in sprouting, although loss in weight as well as percentage shrinkage are lowered; the above behaviour was noted both at room temperature as well as in the regrigerator, more clearly in the latter. In variety Phulwa trends opposite to those observed for Military Special, are noted, while percentage loss in weight as well as percentage shrinkage are increased or even not affected at all.

Studies on the above problem are still in progress.

141. On the Response of Germination of Seeds to Sound-Waves.

T. C. N. SINGH and V. NAINAN, Annamalainagar.

The present investigation is directed towards twelve species of seeds belonging to four different families of the vegetable kingdom namely, Graminae, Leguminosae, Crucifereae and Solanaceae. During the course of study germinating seeds of the aforesaid species were exposed to the sound-waves of an electric bell daily for half-an-hour from 8 A.M. to 8-30 A.M. As a result, it has been observed that earliness of germination in the different species of experimental seeds in comparison to the control, was achieved in *Oryza sativa* and *Psium sativum* by 30%, in *Brassica juncea* by 50%, in *Coriandrum sativum* by 65%, in *Trigonella cornicularа* and *Cicer arietimum* by 70%, in *Cyamopsis tetragonaloba* by 70%, in *Phaseolus mungo* and *Phaseolus radiatus* by 100%, in *Phaseolus biflorus* by 340%, in *Eleusin coracana* by 357% and in *Solanum melongena* by 365%. Besides, the experimental seeds had finished their grand period of germination within a much shorter time than the control; and the seedlings out of the sound-excited seeds were subsequently found to be far more vigorous in their growth performance than those from the control seeds.

142. Mirabilis Mosaic—A New Virus Disease from Nainital.

K. S. BHARGAVA and N. S BISHT, Naini Tal.

A virus disease of *Mirabilis jalapa* has been noticed in Naini Tal. The older leaves show mottling and puckering while young leaves are light green in colour. The thermal inactivation point is between 50-55°C and the dilution end point is 1 : 1000. The virus is of non-persistent type and is easily transmitted by *Myzus persicae.*

143. A *Rhizopus* Causing Soft Rot of Bottle Gourd (*Lagenaria Vulgaris* Ser.).

G. G. DALELA, Agra.

This is a report of a species of *Rhizopus* causing soft rot of young fruits of *Lagenaria vulgaris* Ser. found in October-December at Agra. The species confines to the following measurements and description.

Sporangia almost spherical, measuring 66·0--115·5 μ (mean 84·97 $\pm$ 3·33 μ) by 49·5-99·0 μ (mean 73·19 $\pm$ 2·93 μ), black; columella hemispherical; spores hyaline, sub-globose, measuring 4·95-11·55 μ (mean 8·25 $\pm$ 0·30 μ) by 3·30-9·90 μ (mean 6·47 $\pm$ 0·28 μ).

144. Report of a Downy Mildew on Balsam Plants from Kumaon Division.

S. C. GUPTA, Naini Tal.

A downy mildew on *Impatiens balsamina* Linn., caused by *Plasmopara obducens* Schroeter, has been collected from several places in the vicinity of Naini Tal during rainy season.

Only the leaves of the host are attacked. Pale yellow spots of variable size are first evident on the upper surface of the leaf. The lower surface of the spots soon show conspicuous aerial, downy, milk-white hyphae which slowly turn grey. Later the infected portions of the leaf are killed.

The coenocytic mycelium is strictly intercellular sending globular haustoria into the host cells. Branched conidiophores come out through stomata in groups. Conidia germinate by the formation of zoospores. Sex organs are formed in abundance inside the host.

This is the first report of *Plasmopara obducens* on *Impatiens balsamina* from Kumaon Division.

145. A possibility of Physiologic Specialization in *Protomyces macrosporus* Ung. on *Coriandrum sativum* L. I.

J. S. GUPTA and S. SINHA, Agra.

Disease intensities of *Protomyces macrosporus* Ung. on mature plants of *Coriandrum sativum* L were estimated and infection reactions were classified on the already developed technique (Gupta, 1954) as (i) resistant (disease intensity ranging from 1-10%), (ii) mild (10-25%), (iii) susceptible (25-50%), (iv) virulent (50-75%) and (v) highly virulent (75-100%) types. Ten varieties of *coriander* were tested, each with eight samples of the inoculum obtained from localities widely separated in Uttar Pradesh and also one from Behar.

The reactions indicate generally that a given variety of the host shows different types of infection with inocula of different sources and also given inoculum reacts differently with at least some host varieties. An analysis of reactions, the host varieties and the fungus samples indicate that the samples of the parasite can be grouped roughly in three categories. Inoculum from Moradabad mostly shows Types 4 and 5, Meerut sample reacts under Type 1 and 2 and the rest under Type 2 and 3, indicating the probable existence of three physiologic races.

146. Synchytrium on Cucurbitaceae.

S. SINHA, Agra.

New Cucurbitaceous hosts infected with *Synchytrium* have been collected from field near Agra. Of these, leaves and stems of *Cucurbita pepo* show infections of *Synchytrium lagenariae* Mahtre and Mundkur and *S. trichosanthidis* Mahtre and Mundkur occurs on *Cucumis melo* var. *pubescence* Willd. *Luffa acutangula* Roxb. and *Luffa aegyptiaca* Mill., *Cucumis sativus* Linn. and *Citrullus vulgaris* Schard. var. *fistulosus* in Field Gord. Crops (11) have also been found infected with *Synchytrium* and are under investigation. The specimens are deposited in the Herb. Crypt. Ind. Orient of the Indian Agricultural Research Institute, New Delhi and in the Department of Botany, Agra College, Agra.

147. Laboratory Tests on the Effect of Fungicides and Synthetic Phytohormones on the Chlamydospore Germination of Protomyces Macrosporus Ung.

S. B. MATHUR and S. SINHA, Agra.

A laboratory assay of some fungicides and synthetic phytohormones was carried out on the germination of chlamydospores of *Protomyces macrosporus* Ung., the causal organism of stem-gall disease of coriander. Following modified Rideal-Walker technique, the effect of fungicides viz. Wettle Sulphur, Blitox, Dithane, Coppesan, Aretan and Agallol and synthetic phytohormones 2,4-D, NAA & IAA was studied on percentage inhibition of chlamydospore germination.

Fungicidal tests were made with concentrations of 0, 10, 100 and 1000 ppm. while the effect of phytohormones was assayed in concentrations of 0, 0·1, 1, 10, 25, 50, 75, 100, 125 and 1000 ppm.

The results indicate that Blitox, Aretan, Agallol and Dithane are more effective than the two remaining fungicides; almost complete inhibition being obtained at 100 ppm. concentration. Wettle sulphur and Coppesan result in 98·5% and 91·9% inhibition respectively even at 1000 ppm. concentration. In respect of the hormones NAA completely checks the germination at 50 ppm. while 2, 4-D and IAA are similarly effective at 75 ppm. and 125 ppm. respectively showing thereby that NAA is the most effective. Even on the LD 40 dose basis, NAA proved to be superior over all the other chemicals tested because 53% inhibition was obtained in NAA even at 1 ppm. while others do not reach effective inhibition value at this dilution.

148. Physoderma on Trifolium Alexandrinum Linn.

K. S. THIND and S R SHARMA, Amritsar.

A *Physoderma* species was found on 'Berseem' plants during the months of March to May of 1957 and 1958 in the Khalsa College farms, Amritsar. 'Berseem' (*Trifolium alexandrinum* Linn.) is an important and most prevalent leguminous fodder crop in the Panjab. The disease causes severe and profuse gall formation on the lower part of the stems It is intersting to report that the fungus does not cause any distortion or stunting of the host. Morphology of the fungus and pathological histology of the disease were studied in detail. The resting sporangia were also germinated and the fusion stages between the zoospores were obsrved.

This *Physoderma* species appears to be a new one. It differs from all the *Physoderma* species so far reported on the leguminous hosts. The size of the plano-convex sporangia of the present species falls within the range of those *P. alfalfae*, and on this basis we might say that it is identical with that species. It may, however, prove to be a new species or a biological race, but this cannot be answered until extensive host range studies have been made. Further work is in progress.

149. Disease Appraisal and Crop-Loss Estimate of Powdery Mildew of *coriander* caused by *Erysiphe polygoni* D.C.

J. S. GUPTA and G. G. DALELA, Agra

The powdery mildew of coriander caused by *Erysiphe polygoni* D.C. appears towards the end of March and spreads rapidly by the first week of April. The loss is very severe in a relatively late-sown crop, because disease appears at the full-bloom stage. 100 randomized mature plants were selected in a field near Gwalior and observations were recorded on disease intensity, height of the plants, shoot-dry-weight, grain-yield and number of umbels. The disease was appraised by reducing the visual symptoms to a quantitative index. One whole plant with a total score of 100 points was divided into three parts : main stem carrying 20 points, leaves and umbels with 40 points each. The loss was also estimated as percentage loss in expected yield.

Correlation coefficients (r) between (i) total disease intensity and growth characters and (ii) disease intensities on various plant parts and certain growth characters were calculated; wherever 'r' values were significant regression co-efficients (b) were also estimated. The loss in expected yield per plant amounted to 90·5% with a mean total disease intensity of 83%. The disease intensities either on leaves or on umbels were higher than on stem. A positive correlation (±0·788, significant at 1% level) was noted between total disease intensity and loss in expected yield but a negative correlation (−0·566) was found between total disease intensity and number of umbels. Similarly all 'r' values between disease intensities on various plant parts and growth characters were highly significant. Regression value (b) indicated that every 10% increase of diseased intensity resulted in an enhancement of loss in expected yield by 10% and a decrease in number by 5·6.

150. Disease Appraisal and Crop-Loss Estimate of Rust of Gram.

G. G. DALELA, Agra.

The rust of gram (*Cicer arietinum* L.) caused by *Uromyces ciceris-arietini* (Grogn.) Jacz. appears rather late in the season and therefore doubts have been expressed as to the losses caused by the parasite. In order to ascertain the exact position of loss, random samples from an infected field in the district of Gwalior (M.P.) were taken according to the 'individual method' suggested by Chester (1950) and disease appraisal and loss estimates carried out.

During *rabi* 1956-57 one hundred plants were selected at random from a mature crop in a cultivator's field, and observations were recorded on the disease intensity, growth (shoot dry weight) and yield as well as of seed and pod numbers. Seed-to-pod ratio (by number) and seed-to-shoot ratio (by weight) were calculated. Disease intensity was measured quantitatively as the percentage of infected leaves in total number of leaves on each plant.

Correlation coefficients as well as regression values between disease intensity and shoot dry matter, yield of seeds, 100 seed weight, number of seeds, number of pods, seed-to-pod ratio and seed-to-shoot ratio have been calculated on the lines suggested by Greaney (1933 a & b) to investigate the influence of increasing disease intensity of the rust of gram on the above characters.

It was noted that the shoot dry matter, seed yield, number of seeds and also number of pods were adversely affected by the disease. The remaining agronomic characters, however, bore no relationship.

A mean loss of 0·38 gms. in yield per plant was found with each increase of 10% disease intensity.

151. Soil pH and Rust Development in *Puccinia Penniseti* Zimm. On *Bajra* (*Pennisetum Typhoides* Stapf & Hubb.).

G. G. DALELA, Agra.

Influence of pH (4·6, 5·6, 6·6, 7·4, 8·4 and 9·2) was studied on percentage inhibition of the uredospores of *Puccinia penniseti* Zimm. and also on the development of the rust disease on bajra, the number of pustules per unit area and per leaf taken as index of disease development. Disease development was studied on bajra seedlings grown in sand cultures irrigated with modified Shive solution and pH levels adjusted by using N/10 NaOH and N/10 HCl as buffers.

The least inhibition of uredospore germination was noted at pH 7·4 and increased on either side, more so in acidic than in alkaline pH. The optimum range for spore germination was found between pH 6·6 to pH 8·4. Disease development on bajra was similarly affected by pH, the maximum development being observed at pH 7·4.

A possibility is indicated for the occurrence of a close association between spore germination and rust development.

152. A further Contribution to the Study of Physiologic Specialization in *Puccinia Penniseti* Zimm. On *Bajra* (*Pennisetum Typhoides* Stapf & Hubb).

G. G. DALELA and S. SINHA, Agra.

Continuing work on physiologic specialization in *bajra* rust (*Puccinia penniseti* Zimm.) fourteen more varieties were tested with eight samples of this rust collected from distant localities. The rust samples were obtained during September-October 1956, and maintained at Agra during October to March and at Simla during March to September on *bajra* variety Agra Local.

Bajra seedlings of the varieties under study were inoculated at 2 to 3 leaf stage following the usual technique of rust infection. The rust reactions were noted two weeks after the inoculation following, for preliminary differenitation, the rust reaction key used for wheat rust by Stakman and Levine (1922).

The results indicate that all the varieties are susceptible to the rust and also there are no distinct differences in infection types. 3 and 3-4 type of reactions (vide key of Stakman and Levine) were observed as also noted in the previous year with reference to another 29 *bajra* varieties. A possibility is indicated that none of the varieties may behave as a 'differential' for this rust. Further work on the problem is in progress.

153. A new species of *Puccina (P. xanthocarpi* sp.nov.).

R. Y. ROY and SUDESH KUMAR GUPTA, Varanasi.

This paper deals with the report of a new species of *Puccinia* on *Solanum xanthocarpum* Schrad. and Wendl. It causes severe infection on the leaves.

Uredosori spherical to elongate, 0·5-1·5 mm. brown, amphigenous but more on the upper surface. Uredospores single celled, pedicellate, smooth and thick walled. Paraphyses present.

Teleutosori black, amphigenous but more on the upper surface, spherical 1-3 mm. in diameter. Teleutospores two celled, pedicellate, oblong, smooth and thick walled.

154. A new species of rust on *Alhagi camelorum* Fisch.

R. Y. ROY and M. SHUKLA, Varanasi.

This paper deals with the description of a species of rust on *Alhagi camelorum* Fisch. which has not been reported so far on this host. Only uredospores have been found. The absence of teleutospores makes difficult at this stage to give this fungus a generic name.

The infection appears first in January and continues till the end of April. Uredosori amphigenous, more on lower surface, spherical, 0·75-1·5 mm. in diameter, deep brown; uredospores oval to spherical, rarely elliptical, pedicellate, one celled, thick, wall echinulate, measure 18·18 – 25·20 × 18·18 – 21·60 μ Stalk 21·60 – 43·20 × 4·56—6·02 μ; paraphyses present, hyaline, swollen apically, either on the same level as the uredospores or projecting above; no peridium.

155. *Fomes applanatus* (Pers. ex. Wallr.) Gill on *Quercus incana.*

A. C. SAHGAL, Nainital.

Sporophores of *Fomes applanatus* were found growing on a stump of *Quercus incana*, in Nainital. The morphology and anatomy of the pathogen, its cultural characteristics and reaction on media containing gallic and tannic acids and gentian violet were studied.

The pileus and the herbs growing within a radius of 9″ were found to be covered with a brown pulverulence which on examination was seen to consist of basidiospores of the fungus blown about by air current.

The fungus grows rapidly on 2% malt agar. Mat, white at first but assumes light yellow colour after two weeks, zonate, depressed round the inoculum. *Hyphae of advancing zone* :—parallel and appressed or slghtly raised above the substratum. The newer growth is sparse, cottony and raised, later becoming compact. Odour none, reverse unchanged. Reaction on gallic acid agar weak; on tannic acid agar strong; on gentian violet, medium gets discoloured.

Hyphae of advancing zone :—hyaline, branched, nodose-septate, 2·1-4·2 μ diameter. Aerial mycelium : (a) Hyphae as in advancing zone, (b) Fiber hyphae—1·4-2·8 μ, aseptate, branched, without clamps, walls thick and refractive, lumina narrow. *Submerged mycelium* :—as in aerial zone but much branched—branching irregular and close together. Older hyphae septate. No basidospores and no conidia produced in culture.

Very young hymenial layer of the sporophore consists of large inflated cells (basidia ?) 8-11·2 μ in diameter, against which brown truncated spores 6·3-8·4 × 4·2-5·6 μ are seen.

156. *Colletotrichum* sp. on Citrus.

K. S. THIND and G. S. RAWLA, Amritsar.

An anthracnose of *Citrus limon* and *C. aurantifolia* has been observed in the Khalsa College Nurseries during the Monsoon months since 1956. Morphologically *Colletotrichum* sp. causing anthracnose of these hosts is markedly different from *C gloeosporoides* Penz. which causes the common anthracnose of Citrus. It is allied to *C. capsici* which is reported to infect Citrus by artificial inoculation (Butler and Bisby 1931). However, its conidia are small for *C. capsici* while its setae are larger. Attempts to infect *Capsicum annum* with this *Colletotrichum* species have failed so far, although *C. capsici* was able to infect these Citrus hosts. The study carried out so far appears to indicate that this fungus is a new species of *Colletotrichum*. Experiments on the host range of this species will be carried out.

157. pH of sterilized and unsterilized Garden Soil in relation to *Fusarium* wilt of Gram.

S. K. CHAUHAN, Agra.

Wilt of gram (*Cicer arietinum* Linn.) caused by *Fusarium orthoceras* App. & Wr. has been studied in relation to varous ranges of soil pH both acidic and alkaline in sterilized and unsterilized garden soils. The experiment was planned to enable statistical analysis and interpretation of data. Twelve replications were maintained for each treatment both for the experimental set and the control. Sterilized and unsterilized soils with five pH ranges (4·5, 6 0, 7 1, 7 8 and 9 2) were considered. The soil of each pot was inoculated uniformly and ten seeds were sown in each pot.

When wilting started the mortality was recorded at regular intervals for each treatment in each pot separately. However, none plants wilted in the control. The figures for total mortality were analysed statistically. The effect of pH individually and the interaction between soil condition (sterilized and unsterilized) and soil reaction has been found to be significant.

In sterilized soil the mortality was low in alkaline series (pH 7·8 and 9·2) and in acidic ranges it was either equal to that of neutral (pH 7·1) or even higher. On the other hand in unsterilized soil mortality was higher in alkaline range and diminished considerably in acidic reaction.

It is noteworthy that in sterilized soil alkaline reaction retards the disease while in unsterilized soil the effect is just the opposite, acid ranges bringing down mortality.

158. Disease Intensity and Crop-Loss correlations in *Fusarium* wilt of Gram (*Cicer arietinum* Linn.) As influenced by pH in Sand Cultures.

S K. CHAUHAN, Agra.

Wilt of gram (*Cicer arietinum* Linn.) caused by *Fusarium orthoceras* App. & Wr. has been studied in relation to six different pH levels (4·6, 5·6, 6·6, 7·4, 8·4 and 9·2) in sand cultures in glazed pots. A modified Shieve three salt nutrient solution was supplied to the growing plants. The hydrogen-ion concentration of the solution was altered by adding normal NaOH and HCl as buffers. Six replications (6 pots with 7 plants each) were maintained throughout the course of the investigaiton in the experimental set as well as in the control. The experimental set was uniformly infested with the pathogen. Observations were recorded on the seed yield, seed number, pod number, shoot dry weight and also on disease intensity at the time of the harvest. The disease intensity was appraised following the technique evolved by the author (1957). The data were analysed statistically.

It is indicated that the sand pH has got a positive influence on the incidence of the disease. Maximum disease (70·41%) was observed in 5·6 pH and the least (0·63%) in pH 9·2. In general the disease is directly proportional to the increase in H-ion concentrations within the ranges employed.

Correlation coefficients were significant between disease intensity and loss in seed yield at pH 4·6, 6·6, 7·4, 8·4. They were nonsignificant at pH 5·6 and 9·2 where the disease intensity is maximum and minimum respectively. Correlations were also significant at pH 6·6 and 7·4 between disease intensity and loss in seed number. However, no significant correlations could be obtained between the disease intensity and loss in pod number or dry weight of shoot.

Regression coefficients for significant 'r' values indicate that the loss in seed yield amounts to (0·0194, 0·0132, 0·0171 and 0·0084) gms. for pH 4·6, 6·6, 7·4, and 8·4 respectively for unit increase in disease intensity. Irrespective of pH the loss in seed yield amounts to 0·0152 gms. for 1% increase in the disease intensity. Again for an unit increase in the intensity of the disease the loss in seed number is 0·6165 and 0·5160 at pH 6·6 and 7·4 respectively, where as it is 0·575 if all pH ranges are taken together.

159. A note on *Olpidium* parasitic on *Phaseolus aconitifolius* Jacq.

S. SINHA, Agra.

An *Olpidium* occurring on *Phaseolus aconitifolius* Jacq. in Agra causes gall formation on the under surface of infected leaves. The galls are very minute and are formed due to the enlargement of the infected host cell and also by the division of the adjoining cells. The galls ultimately collapse and leave a brown patch on the leaf surface as if eaten away by insects. Heavily infected leaves have numerous such patches and appear far from being normal. The disease seems to be favoured by very wet conditons as infection spreads after heavy showers of rain. The structure of the parasite has been studied The entire thallus is transformed into the developing zoosporangium which puts out a discharge tube. Resting sporangia are also formed and have thick wall. The specific identity of the parasite is under investigation.

160. A Fusarium wilt of Vinca Rosea.

S. SINHA and S. K. CHAUHAN, Agra.

Seedlings and adult plants of *Vinca rosea* Linn were found to wilt soon after heavy showers of rain. In the first year (1954) only the white flowering variety was affected although the pink variety was growing mixed with the former but from the next year the pink variety also began to wilt. The usual symptoms of *Fusarium* wilt appear and 'vein clearing' is very characteristic. Apart from these symptoms the affected twigs of the white flowering variety bore masses of sporodochia, an unusual feature in Fusarium wilts. Often a mature plant does not show complete wilting; some lateral branches remain healthy and do not contain any mycelium inside the wood or cortex. When seedlings are affected losses are cent per cent.

Three isolates were obtained, one from the wilted seedlings and wilted branches of adult plants of white flowering variety which also yielded the sporodochial type and the third from the pink flowering variety. Curiously enough the forms yielded by the white variety of *Vinca rosea* does not infect the pink variety, and the one obtained from the latter failed to infect the white flowering variety. Cultural and morphological characters of the isolates reveal their distinct identity from one another. Two of these have been identified : *Fusarium solani* (Mart.) App. & Wr. from the roots, seedlings and stem of the white flowering varety and *Fusarium scirpi* from the sporodochial matter. The *Fusarium* on the pink flowering variety is under investigation.

161. A new species of *Helminthosporium* (*H. dinebrae* sp. nov.).

R. Y. ROY and M. SHUKLA, Varanasi.

In this paper a species of *Helminthosporium* on the inflorescence of the grass *Dinebra* sp. has been described. It attacks ovaries in the inflorescence. The infection apparently resembles smut infection. It has agglutinised sooty spores. Conidiophores yellowish brown, septate, in groups, geniculate; conidia cylindrical, commonly 2-septate, borne singly on the apices of the conidiophores.

162. Angular Black spot disease of *Sesbania grandiflora* Pers.

R. Y. ROY, S. N. RAO and G. KRISHNA (MISS), Varanasi.

A leaf spot disease on *Sesbania grandiflora* Pers. caused by a species of *Protomycopsis* was recently observed in Varanasi. It appears as pale brown angular spots, gradually deepening to chocolate brown, finally turning to black blisters. The blisters are usually 6·9 x 3·9 mm., often coalescing to form patches.

The mycelium is intercellular, scanty and short, developing numerous reddish brown terminal resting spores interspersed in the intercellular spaces. Young spores are at first hyaline, thin walled and pyriform. Mature spores are reddish brown, thick walled, distinctly verrucose, globose to sub-globose or oval, 22 55 x 19·58μ.

Comparative studies indicate that the fungus in question differs from all the previously described species in having (i) angular leaf spots resembling blisters; (ii) small sized sub-globose resting spores; (iii) distinct verrucose wall of 5·0μ thick. So the name *Protomycopsis sesbaniae* is proposed.

163. A new species of *Piricularia* (*P. tinosporæ* sp. nov.).

R. Y. ROY and R. S. DWIVEDI, Varanasi.

During August 1958, a fungus was collected growing parasitically on and causing great damage to the leaves of *Tinospora cordifolia* Miers, a plant of great medicinal value, in Varanasi. An examination of the infected leaf revealed the presence of an interesting species of the genus *Piricularia* which differs markedly from all the previously described species in having longer conidia and deserves a new specific rank.

The fungus forms irregular angular spots on the lower surface of the leaves, white to ashy, scattered or sometimes coalescing; conidiophores emerging through the stomata or epidermis from the intracellular black tufts of hyphae, in clusters, hyaline, geniculate. Conidia hyaline, straight, obclavate, singly arranged on the conidiophores in scorpioid cyme, smooth walled, 1—3 septate, apex tapering, basal end broadest and with a hylum-like terminal which marks the point of attachment to the conidiophores, 18—21 x 7·2—10 8μ.

164. The Scab disease of cultivated and wild figs in Bombay State.

D. D. WANI, Poona.

Scab disease of figs incited by a *Sphaceloma* species is widely prevalent in several parts of Bombay State. On cultivated figs the disease appears as numerous yellowish-white minute leaf spots which often cover the entire leaf surface. The disease is severe in the months of August to November and hasten defoliation. Petioles and young fruits also show numerous infection spots. Acervuli are 9 to 50μ broad and 17 to 37μ high, brownish yellow, composed of compactly grouped cells. Conidiophores are 6 to 12μ long and mature conidia have not been observed. In the types of symptoms produced and measurements of fruiting bodies the fungus under study differs from *Sphaceloma fici* Thirumalachar described on *Ficus glomerata* and also from *Sphaceloma Caricae* Ikata and Katsuka described on cultivated figs from Japan. The latter produces numerous conidia which are 2 celled.

On *Ficus religiosa, Ficus Palmata* and *Ficus glomerata,* the same *Sphaceloma* species occurring on cultivated figs has been collected. On two other species of *Ficus* viz. *Ficus infectoria* and *Ficus retusa, Sphaceloma fici* Thirumalachar has been collected.

165. "The incidence of Air-Borne Spores in the Potato Plantations of Upper-Shillong".

G. KONGER and H. K. BARUAH, Gauhati.

The fungi and bacteria pathogenic to potatoes are isolated from infected tubers, soil and from skin of the healthy potato tubers and include *Fusarium oxysporum* Schl. St. A., *Fusarium oxysporum* Schl. St. B., *Fusarium oxysporum* Schl. St. C., *Fusarium radicicola* Schl. St. A., *Fusarium radicicola* Schl. St. B., *Fusarium radicicola* Schl. St. C., *Bacterium carotovorum* St. A., *Bacterium carotovorum* St. B., *Bacterium solanacearum* St. A. and *Bacterium solanacearum* St. B.

Spore trapping by the petridish method and exposing smeared slides showed the incidence of air-borne spores of *Phytophthora infestans* (mont.) de Bary., *Albugo* sp., *Pythium* sp., *Mucor* sp., *Mucor racemosus, Penicillium* sp., *Penicillium digitatum, Aspergillus* sp., *Aspergillus niger, Puccinia* sp. *Fusarium oxysporum, Fusarium radicicola, Fusarium solani, Thielaviopsis paradoxa, Bacterium* sp., *Bacterium solanacearum, Bacterium carotovorum* and *Corynebacterium* sp. in the plantations and in the storage chamber. The pathogenicity of the types specifically parasitic on potatoes is described.

165a. Treatment of Ipecac cuttings with Hormones and other Minerals.

SALIL KUMAR CHATTERJEE, Darjeeling.

(1) Experiments establish the effects of hormone NAA and of some essential elements (Calcium, Iron, Magnesium, Potassium and Phosphorous) on induction of roots of cuttings of Ipecac (Psychotria Ipecacuanha) plants.

(2) Hormone NAA was applied directly and also with normal nutrient and different substitution solutions. The effects were also followed with normal nutrient and substitution solutions. Rootings data was collected after 45 days.

(3) Results show high rooting intensity (indicated by total length of roots in cm., their fresh and dry weights in gms) in cuttings treated with normal nutrient solution. The cuttings treated with normal solutions deficient in Fe, K, P, Mg and Ca respectively showed comparatively lesser rooting intensity but in almost all cases the rooting response was greater than untreated controls.

(4) Rooting intensity becomes maximum in the cuttings treated with the nutrient solution containing NAA. In other cases where hormonal nutrient solutions are deficient in Fe, K, P, Mg and Ca respectively, cuttings show lesser rooting response. In each case, however, the intensity of rooting is greater than the deficient treatments alone (without hormones).

(5) Exclusion of any one of the essential elements may be supposed to disturb the nutritional condition of the cuttings which require to be optimal for rooting of the untreated controls. And augmentating effects of NAA on rooting intensity shows the necessity of a hormonal substance for rooting in cuttings. Thus a balance of internal factor whether nutritional, hormonal or both influence the optimum formation of roots in cuttings.

VI. CYTOLOGY AND CYTOGENETICS

166. Some Cytological Observations on *Oedocladium Operculata* Tiff.

S. N. UPADHYAYA, Varanasi.

The paper deals with some aspects of cytology of *Oedocladium operculata* Tiff. collected from nature as well as that maintained in cultures under controlled conditions. The clone cultures were raised from the apical cells, as in spite of best efforts, this species did not liberate asexual swarmers in cultures.

Aceto-orcein and aceto-carmine were used as nuclear stains after giving the material pretreatment with paradichlorobenzine, acenaphthene and 8-hydroxyquinoline. The chromosome number of the alga was found to be sixteen, and this is the first record for the genus *oedocladium*.

167. Genetics of Aspergillus niger I. Heterokaryosis.

A. K. MISHRA and P. NANDI, Calcutta.

Heterokaryosis was induced and balanced heterokaryons were synthesised between biochemical mutant strains of *Aspergillus niger*. The following pairs of mutants were allowed to recombine.

*(1) 48 a me paba+8 g py arg, (2) 46 a me cyt+8 g py arg, (3) 45 a me bio+44 g py ad, (4) 22 a me arg+42 g py ino, (5) 3 a me thi+54 g py lys, (6) 49 a me lys+44 y py ad and (7) 34 a me le+54 g py lys.

*For each strain the figures indicate the collection number and the symbols have the following meaning. a—avallanceus colour; g—serpentine green colour; me—methionine; py—pridoxine; paba—p-aminobenzoic acid; cyt—cystosine; bi—biotin; arg—arginine; thi—thiamine; lys—lysine; le—leucine; ad—adenine; ino—inositol.

Experiments concerning the isolation of strains from the balanced heterokaryon, carrying heterozygous diploid nuclei in their hyphae, and the selection from heterozygous diploid strains of segregants, are in progress.

168. Interspecific Hybridization in the Genus *Adiantum*.

R. P. ROY and BAXI M. B. SINHA, Patna.

To understand phylogenetic relationships, cytogenetic method has been very profitably utilized in angiosperms. In the case of vascular cryptogams however, studies of this nature have been rather fragmentary. But the utility of this method in tracing phylogenetic relationships of species in cases of ferns, although limited to very few species, have been well demonstrated by Manton and her co-workers. In our country, however cytogenetic studies of ferns which involve raising of interspecific and inter-racial hybrids is almost nil. Pteridologists in this country have mostly confined themselves to the study of meiosis and mitosis of species in different fern genera and in some cases, of the naturally occurring hybrids.

To develop, therefore, the cytogenetical aspect of studies in ferns several interspecific hybridisation in the genus *Adiantum* has been tried in this laboratory and some hybrids have been successfully raised. The hybrids made are :

1. *Adiantum capillus-veneris* × *A. peruvianum.*
2. *A. peruvianum* × *A. capillus-veneris.*
3. *A. capillus-veneris* × *A. aethiopicum.*

The hybrid plants are still at 3-4 leaf stage and therefore their cytological behaviour is deferred for future studies. But their morphological features, when compared to parents, clearly establish their hybrid nature. The morphological characters of the selfed and hybrid sporophytes are given in the tabular form from which the hybrid nature will be evident.

Name of species	Morphological characters of the leaf of selfed sporophytes
1. *A. capillus-veneris* L. ...	Deep green colour, deep notching and uniform shape.
2. *A. peruvianum* Klotz. ...	Pale green colour, shallow notching and different shapes.
3. *A. aethiopicum* L. ...	Green colour, shallow notching and uniform shape.

Interspecific Hybrids :

Crosses	Morphological characters of the leaf of selfed sporophytes
1. *A. capillus-veneris* × *A. peruvianum* ...	Deep green, notching not so deep, size same.
2. *A. peruvianum* × *A. capillus-veneris* ...	Deep green, margin sub-entire i.e. of crisped nature (incision negligible), shape constant.
3. *A. capillus-veneris* × *A. aethiopicum*	Deep green, less notching of lamina and constant shape.

From the above observations it is evident that the deep green colour of leaves is dominant over pale green colour, less notching is dominant over deep notching etc. It further appears that the type species *A. capillus-veneris* still contains most of the dominant genes with respect to above characters and the other species are presumably derived ones and have recessive alelles. More details about these hybrids will be published later.

169. Studies on inducing polyploid flower plants and their utilization —*Iber's umbellata* L.

P. N. BALI and S. L. TANDON, Delhi.

This paper is concerned with the work done on colchicine-induced tetraploidy in *Iberis umbellata* L. The induced tetraploids were characterized by thicker, rough and deep green leaves having larger epidermal cells with more widely spaced and larger stomata. Although there was no significant difference in the flower size of the 2n and 4n plants, the latter flowered much later and continued to flower even when most of the diploids had fruited. The pollen grains of the tetraploids were larger than those of the diploids, but pollen-fertility in the former was much lower. The fruit and seed-setting in the tetraploids was extremely poor in comparison with that of the diploids.

The chromosome numbers of the 2n and 4n were determined as $n=9$ and $n=18$ respectively. The diploids showed 9 bivalents at diakinesis and metaphase I. The distribution of chromosomes at anaphase I was mostly regular in the diploids but occasional abnormalities of the type reported for 4n were also observed. The tetraploids showed 18 bivalents at metaphase I. Some of the configurations seen at diakinesis in 4n were ^{9}IV, ^{8}IV ^{2}II, ^{5}IV ^{8}II, ^{4}IV ^{10}II, ^{3}IV ^{12}II and ^{2}IV ^{14}II. Frequency of abnormalities like unequal distribution of chromosomes at anaphase, laggards and chromatin bridges was very high in the 4n, which may account for the low pollen-fertility and consequently poor fruit and seed-setting in the tetraploids.

As the induced tetraploids showed an extended period of flowering, it may be possible to evolve useful superior types by further breeding.

170. Studies on inducing polyploid flower plants and their utilization— *Alyssum maritimum* Lam.

P. N. BALI and S. L. TANDON, Delhi.

This paper deals with the work done on colchicine-induced polyploidy in *Alyssum maritimum* Lam. From the point of view of induction of polyploids, treatments given to growing points of 46-days old seedlings with 0.20% aqueous solution of colchicine for 6 hours gave the best results. The colchicine-induced polyploid was larger in every morphological comparison made with the control. The stomata and pollen grains of the polyploids were also bigger. The number of stomata per unit area in the polyploids was, however, less than the control. The pollen fertility was rather low in the polyploids. Fruit and seed-setting in the polyploids was extremely poor, but size of the polyploid seeds was much larger.

Meiosis was studied in the control as well as induced polyploids. The meiotic chromosome number of the control plants and polyploids was determined as 12 and 24 respectively. The former showed 12 bivalents at diakinesis and metaphase I, the distribution of chromosomes at anaphase I being mostly regular. Many of the possible configurations at diakinesis and metaphase I showing varying number of quadrivalents, bivalents and univalents were seen in the preparations of the induced polyploids. In some of the pollen mother cells the distribution of chromosomes was quite regular but in many of them a few chromosomes were seen to lag behind resulting in the unequal distribution of chromosomes. In a few pollen mother cells anaphasic bridges were also observed. Formation of varying numbers of multivalents, lagging chromosomes at anaphase, and formation of chromatin bridges may be the probable causes for the low pollen-fertility and consequently poor fruit and seed-setting in the polyploids.

The presence of conspicuously large flowers in the artficially-nduced polyploid *Alyssum maritimum* Lam. suggests a possibility for selection of a desirable type for introducing in the horticultural trade.

171. Studies in the essential oil-yielding plants of India. IV—Further observations in the progeny of the colchicine-induced polyploid plants of *Ocimum Kilimandscharicum*, Guerke.

R. B. BOSE and J. K. CHOUDHURY, Calcutta.

It was reported on an earlier occasion (Proc. Ind. Sc. Congress, Part III, p. 248, 1957) that *Ocimum kilimandscharicum* Guerke was successfully induced to polyploidy by treatment with 0 01% colchicine and that the induced plants were bigger in size and gave a larger outturn both of raw material and of volatile content.

Subsequent cytological observation showed a longer range of chromosomal variation from n=4–76 and it appeared that, on the frequency of their numbers, they might be classified into three groups, viz. n–4–32, n–38–57 and n–64–76. The frequently found multivalents were quadrivalent and they varied from 0—8. Such irregularities were found in nearly 40% of the p.m.c. Presence of very high and low number and haploid and diploid gametes in the same anther was also observed. In diakinesis chromosomes were found attached to nucleolus. Chromosomes also exhibited a tendency to group together.

Pollen grains of induced plants were of three sizes, viz. 47—52μ, 53—62μ and 66–71μ, while the pollen size of diploid was 52–60μ. Pollen sterility in polyploid and diploid were nearly 50% and 8%, respectively.

Morphological variations were observed in some of the polyploids raised at Calcutta, Haringhata and Sukna. A field trial is in progress at Sukna and the plants are being analysed for their camphor and camphor oil content.

172. Cytology of a x-ray mutant in *Corchorus capsularis* L.

RABINDRA KRISHNA BASU, Calcutta.

A dwarf mutant was isolated in the third generation following irradiation with x-rays on dry seeds of *Corchorus capsularis* L. var *D 154*. This plant was unusually short, bearing very narrow lanceolate leaves. The flowers were normal and their number was reduced. The chief characteristic of this mutant was the presence of capsules of varying sizes. The capsules, which were unusually small in size did not yield any healthy and mature seeds; even the fruits which attained normal sizes contained very few viable seeds. The capsules were smooth with shallow ridges. Germination of seeds in the subsequent generations was found to be as low as 9·1% only. All the surviving plants showed mutant character in later generations. The chromosome number of these plants was found to be 2n=14. Meiosis in microsporogenesis was irregular. Univalents were often seen in prophase, metaphase and anaphase of the reduction division. Chromosomal fragments, bridges, non-disjunction of bivalents, equational division of univalents and exclusion of chromosomes and fragments were common at anaphase I; while the formation of euploid and aneuploid nuclei and failure of splitting of chromosomes occurred fairly regularly at anaphase II. Pollen grain sterility was found to be about 58%. Reduction of pollen fertility was partly due to cytological causes, in others it seemed to be genetic.

173. Cytogenetical studies of a fertile, parthenocarpic, diploid wild *Eumusa—Neerbalai.*

S. GOVINDASWAMI, Cuttack.

During the study of the wild and cultivated species and varieties of *Musa*, a fertile, parthenocarpic diploid variety was isolated. This variety called *Neerbalai* was collected by the author from the Western Ghats adjoining Mysore during the year 1950-51. The fruits were small (like the fruits of the cultivated varieties *Lal-velchi* or *Poovan* with thin skin) borne on a number of hands. It was fully seeded and the seeds were black, tubercled and 1/8 inch in diameter. The cytological study of this plant is presented here.

The 2n number of this plant was 22 and the karyotypic formula was A_2 C_2 E_4 G_6 K_4 M_2 N_2. The somatic chromosomes showed the presence of a large number of nucleolar constrictions comprising both typical satellites and secondary constrictions. The occurrence of chromosomes (A-type) with satellites on both ends and chromosomes (M-type) with only the long drawn out stalk without the satellitic head being present was a special feature of this type.

Owing to their smallness the meiotic chromosomes could be studied only from diakinesis onwards. Usually 11 bivalents were regularly observed during metaphase I. The other associations met with were 10 bivalents 2 univalents; 9 bivalents 1 quadrivalent; 9 bivalents 1 trivalent 1 univalent and 9 bivalents 4 univalents. Occasionally two metaphase plates, one having 7 bivalents and another having 4 bivalents orientated with clean spindles of their own were also met with.

The anaphase separation of the chromosomes was usually normal, the daughter cells getting 11 and 11 chromosomes; but where the chromosome associations were abnormal, the distribution of chromosomes to the daughter cells varried from 9 to 13 chromosomes. Apart from this, occasionally the lagging chromosomes formed micro-nuclei in the cytoplasm leading to the formation of more than 4 microcytes. The pollen grains were 90 to 95% fertile.

The observations of the somatic chromosomes led to the inference that this wild variety *Neerbalai*, retains some of the primitive characters of the genus *Musa*. It has probably a hybrid origin. It possesses the useful character viz., parthenocarpic development of fruit and hence can be utilized as a pollen parent in the hybridisation programme for evolving better cultivated types.

174. Cytotaxonomy of Ludwigia parviflora Rox.

MARY KORAH, Calcutta.

The somatic chromosomes of *Ludwigia parviflora* Rox. (Family—*Onagraceae*) have been studied. It has been found that the 2n chromosome number of the species is 16. So far as the author is aware this is the first report of the chromosome number in the genus.

The somatic complement has been analysed on the basis of the length of the chromosomes and the median or the submedian position of the centromere. It has been found that there are five pairs of morphologically distinguishable chromosomes, the smallest of which has multiplied four times to bring about the required 2n number.

From the evidence of the number of the nucleoli organised, it has been concluded that it is a diploid species; while on the basis of the medianly and submedianly constricted chromosomes, a relatively primitive position has been assigned to it.

Summing up the evidences, it has been concluded that the basic number of the species is 5 and the presetn number (n = 8) has been secondarily derived.

Finally, it has been suggested that *Ludwigia* comes nearer to the genus *Clarkia* in the same family, as 5 has been reported to be the basic number in the latter genus also.

The necessity of further investigations in the other species of this genus and a comparative study with *Clarkia* has been indicated.

175. Practical hints to Rice Breeders.

BALABHADRO MISRO, Orissa.

Different methods of emasculation of rice were discussed and data proving the relative efficacy of the "forcing method" presented. It was observed that the season of crossing has a profound effect on the percentage of setting in rice. Under Orissa conditions, it is lowest in January, sharply rises up to March, after which it remains more or less steady until July. It rises in August. September, October and November are the ideal months. It drops considerably in December.

Short-day photoperiod treatment is given to potted plants to synchronise flowering in the parents, with wide disparity in flowering. In the kharif season, only five plants can be accommodated in each pot (with 12" face diameter and 12" heght). But it was observed that a dozen plants can be accommodated in the rabi season in shallow pans with 3" depth and 12" face diameter.

In a large scale hybridization programme, the crossing has to go on throughout the year. It was, however, observed that the crossed seeds collected between July and October, in spite of most careful storing, lose their viability by July next. Hence, it is worth while sowing these in the rabi season and harvesting as many hybrid seeds as possible and carry over the stubbles to the following kharif season.

176. Cytology of Solanum macranthum Dunn.

U. K. RAI, Calcutta.

The three sterile tall trees of *Solanum macranthum* Dunn, (n = 12) introduced some twenty-five years ago at the Bihar Agricultural College, Sabour, Bhagalpur, flower throughout the year without setting any fruit. Flower buds were fixed in aceto-alcohol (1 : 1) and permanent smear preparation of anthers were made in acetocarmine for the study of meiosis. Various irregularities such as univalents and tetravalent, failure of spindle mechanism, laggards, striation and extrusion; microspindle and unequal chromosome number in daughter nuclei, resulting in the formation of monads to hexads, have been observed. These irregularities have been grouped as (a) irregular behaviour of the chromosomes, (b) irregularities in the formation of tetrads and so in the number of pollen grains and (c) abortive pollen formation from tetrads. In the light of above findings the probable causes of sterility in *Solanum macranthum* have been discussed.

177. X-ray induced high yielding—early flowering mutants in mustard (Brassica juncea).

U. K. RAI, Calcutta.

The paper deals with the behaviour of dominant mutants which not only gave higher number of fruits and greater quantity of seeds, but also flowered earlier than the control. Dry seeds of mustard (*Brassica juncea*) types *Rai 5* (W. Bengal) and *R. L. 9* (E. Punjab) were treated in 1953 with 26,000, 80,000 and 1,00,000 r dosages by a continuous evacuated X-ray tube run at 30 Kv. and 4 mA. current, at a target distance of 8 cms from the tube. Seeds were dibbled in holes 9 inches apart, in lines 1 foot apart, to raise the population of about 300 plants in each treatment and controls. Pertinent data regarding number of fruits, weight of seeds, date of first flowering etc. collected in X_1—1953 to X_5—1957 generations, have been tabulated. One of the X_5 progenies of early flowering *Rai 5*, X_1 selections not only flowered 2 days earlier but also gave greater number of fruits, higher seed weight and greater quantity of oil than the control. Similarly three of the X_8 progenies of early flowering R. L. 9, X_1 selections, not only flowered 3 days earlier but also gave greater quantity of oil, which in the selection II/3/2/9 of 1,00,000 r, is *two times higher than the control.* The possibility of such induced mutation and recombination in obtaining positive results, has been discussed.

178. Cytogenetical investigations in beans, *Dolichos Lablab L.*

R. P. ROY and J. SARAN, Patna.

Dolichos lablab, the common bean is an important vegetable plant. Considering its economic importance it is surprising to find that not much work has been done on the genetical and cytological aspect of this vegetable. There is no unanimity even about its somatic chromosome number; some workers have reported $2n=24$ and others as $2n=22$. Cyotogenetical investigations of this plant have therefore been undertaken and are in progress.

14 selected varieties and some inter-varietal hybrids have been studied genetically and cytologically. There are several important characters which distinguish one variety from the other like the colour of the calyx or bracts, flower colour, fruit size and colour, seed size and colour, colour of the stem, and to some extent leaf colour. Inheritance studies of some of these characters have given clear cut ratios indicating the presence of one or two genes controlling certain characters. Similarly cytological studies of the parent varieties and hybrids have been made. *Dolichos* is not a very favourable material for detailed studies of the chromosome morphology. It is perhaps because of this difficulty that the plant has not received the attention of the cytologists that is due to it. But by using suitable recent techniques quite good mitotic and meiotic plates could be prepared. At somatic metaphase clear 22 chromosomes are seen. Most of the chromosomes have median or submedian centromere. No chromosomes with any satellites have been found.

At first metaphase of meiosis and also at late diplotene and diakinesis several nuclei of each varieties and hybrids have been analysed. Even at the resting stage pro-chromosomes corresponding to the 2n number 22 could be observed. Early diplotene, however, is a diffused stage. Spindle is very conspicuous in a well stained material. At first metaphase of meiosis, rod and ring bivalents with different frequencies are clearly seen. In each bivalent the chiasmata are completely terminalized. Only occasionally a single interstitial chiasma in some bivalents could be seen. In most cases the anaphasic separation is normal but sometimes a lagging bivalent could be observed. The difference in chiasma frequency per cell among some varieties was found to be statistically significant but the mean chiasma frequency of two parents when compared to their hybrids did not show statistically significant difference. As expected, however, the variability in chiasma frequency was greater in the hybrids and followed a distribution pattern of the kind found in the case of quantitative characters. It is, therefore, quite likely that the chiasma frequency is under polygenic control and therefore shows a continuous variation.

Detailed data on the genetical and the cytological studies will be published later.

179. Meiotic studies in Dipterocarpaceae.

R. P. ROY and R. P. JHA, Patna.

Meiotic studies in some species of the family Dipterocarpaceae like *Dipterocarpus alatus, Hopea odorata* and *Vatica grandiflora* have been made for the first time. Previous to this study, only the somatic number of chromosomes in these species were determined by Tixier (1953). This study is a part of the work already reported by the present authors in the case of *Shorea robusta* L. (Roy and Jha, 1956). The meiotic studies have shown normal bivalent formation and normal anaphase separation. The bivalents were mostly of the rod types. The haploid number as counted at the first metaphase of meiosis is as follows :—

Dipterocarpus alatus	10
Hopea odorata	7
Vatica grandiflora	10

In case of *Hopea odorata* the number of bivalents at first metaphase was found to be seven in several cells although Tixier (1953) has reported $2x=20$ in this species. The root tip count of this species has not yet been made in this laboratory to confirm the meiotic number but it is surprising that the same species is showing different chromosome number as reported above. However, it is quite interesting that in the family Dipterocarpaceae *Shorea robusta* has seven as the haploid number and similarly, *Hopea odorata* also has the same number (as reported above), but *Dipterocarpus alatus* and *Vatica grandiflora* have 10 as the haploid number. Detailed cytological investigations are in progress in several other species of this family, so as to find out phylogenetic relationship among them. At present it cannot be conclusively said how the different species in this family have different basic numbers.

Embryological studies and development of testa and other parts are also in progress.

180. Karyotype alternation of some Palms and its significance.

SANTOSH KUMAR SARKAR, Calcutta.

The present paper embodies the results of a part of the research project undertaken to investigate cytological peculiarities of some Palms.

In addition to the normal number of chromosomes in the somatic cells, cases have been recorded with varying chromosome number from somatic complement. Such normal and abnormal nuclei occurs in the same individual and in most cases in the same root-tip. In addition to numerical alteration, structural changes of chromosomes, specially with regard to the position of primary and secondary constrictions, have been recorded. The variation occurs at random in the root tip and no distinct zone of their occurrence could be worked out. The frequency is so high that in species of *Chrysalidocarpus*, *Licuala* and *Rhapis*, these are present in about 40% of the dividing cells. Vegetative propagation occurs in abundance in these species. The role of this phenomenon in speciation has been suggested.

181. Cytological changes involved in tumour formation by alkaloids and plant extracts—I.

ARCHANA SHARMA (née MOOKERJEA), Calcutta.

Investigation has been carried out on the production of tumours and the cytological changes involved therein, by Atropine sulphate, Quinine sulphate and Brucine Sulphate and the bark extract of *Alstonia scholaris*, in the root-tips of *Allium cepa*. The classical *Allium* test was followed. Of the three chemicals, Atropine Sulphate proved to be the most effective though tumour formation, to a greater or less extent, was observed with the others too. Bark extract of *Alstonia scholaris* was very effective in the production of tumours. In all cases, fragmentation of chromosomes, stickiness, somatic bridges, arrested anaphase and polyploidy too were noted. All the cells in the tumour region were found to be very enlarged and the frequency of division was very low. The fate of these tumours in recovery experiments has been followed. Tumour-formation in all these cases, therefore, mainly involves cell elongation rather than rapid cell division with loss of polarity.

182. A study of spontaneous fragmentation in two varieties of *Allium Sativum* L. and interpretation of their karyotypes.

ARUN KUMAR SHARMA and ARYA KUMAR BAL, Calcutta.

The paper reports cytological observations on the two common varieties of *Allium sativum* Linn. The chromosome number has been found to be 2n = 18 in both and the karyotype in the two coincides markedly, though the two varieties are different phenotypically. Spontaneous chromosome breakage, involving only chromosomes with secondary constrictions could be observed in many dividing nuclei. The fragments undergo also translocations involving interchange of parts between the chromosomes possessing secondary constrictions, resulting in the formation of new types of chromosomes. These structural alterations have been shown to play a distinct role in origin of varieties. Occurrence of chromosomal biotypes have been suggested, as the karyotype of the same species in Europe worked out by previous authors and that of the present one vary to a great extent. Though the varieties investigated in the present report do not show any difference in their karyotype, differences have been brought out in the study of their nucleoli.

183. Experimental study to compare the effect of x-ray on the somatic chromosomes of a few species of Monocotyledons.

ARUN KUMAR SHARMA and NRIPENDRA KUMAR BHATTACHARYYA, Calcutta.

Bulbs and rhizomes of *Nothoscordum fragrans, Haemanthus kalbreyeri, Zephyranthes mesochloa, Colocasia antiquorum, Zingiber officinale* and *Curcuma amada* were irradated at dosages of 250r and 500r, and the effect of irradiation was noted. After 48 hours following treatment, heavy fragmentation, formation of micronuclei, structural alteration of chromosomes, lagging etc. were observed in a large number of cases. Frequency of fragments were found to be higher in treatment with 500r than with 250r dosage. This shows that the cells at different phases of interkinetic condition, in these species, become differentially affected following irradiation. This is in contrast to the previous report obtained with bulbs of *Allium cepa,* where all the interkinetic cells were found to be homogeneous as regards their response to irradiation is concerned. It has been suggested that at the time of treatment, certain resting cells were lying at the last phase of interkinetic condition, that is, in a state just prior to germination. The enzymatic activity of these cells, necessary for germination, were completed at the time of treatment and so their germination capacity was not inhibited. In other young resting cells, however, the germination capacity was checked temporarily. Fragments were found to be persisting after several days following irradiation. In *Nothoscordum fragrans,* fragments persisted even up to 2496 hours or one hundred and four days. Instead of assuming that fragments can remain ununited for such a long period, it has been suggested that possibly these fragments have passed through several cell generations, being included at random in the daughter cells and are on their way to degeneration.

184. An investigation on the scope of a number of pre-treatment chemicals for chromosome studies in different groups of plants.

ARUN KUMAR SHARMA and NRIPENDRA KUMAR BHATTACHARYYA,
Calcutta.

Seven different pre-treatment chemicals *viz.*, Aesculin, Paradichlorobenzene, Coumarin, Oxyquinoline, Phloroglucinol, Colchichine and Chloral hydrate were tried on plants of two different families, one (Amaryllidaceae) belonging to monocotyledonous and the other (Umbelliferae) to dicotyledonous groups. Different species, in which the chromosome complements of varying types are present, were chosen for treatment. For example, low number and long size is represented in species of *Crinum kunithianum* and *Foeniculum vulgare.*, high number and long size in species of *Sesile indicum,* high number and medium size in *Pancratium zeylanicum,* low number and short size in *Hemerocallis aurantiaca-major* and *Hydrocotyle asiatica,* and low number and a mixture of medium-sized and short chromosomes in *Curculigo orchioides.* It has been desired to find out whether different species of the same family respond similarly or not, which would give an understanding of the basis of their action. With Amaryllidaceous species, irrespective of the type of chromosome complements they possess, Aesculin has been found to be the best for chromosome clarification of the details of chromosome structure, whereas with Umbelliferous members, Paradichlorobenzene has been found to be most suitable in all the species. The similar response of the members of a particular family with different types of chromosomes is an indication that their cytoplasmic constituents too have certain common characteristics. The response is, therefore, due to common characteristics of the family and not dependent on the total amount of chromatin matter or the types of chromosomes the species possess. It has been emphasized that if a chemical suitable for the members of a particular family can be found out, trials with different chemicals on a chance basis can be avoided.

185. Structural alteration of chromosomes as an aid in the origin of different species and varieties of *Bougainvillea.*

ARUN KUMAR SHARMA and UPENDRA CHANDRA BHATTACHARYYA,
Calcutta.

A critical cytological investigation was carried out on forty different varieties of the genus *Bougainvillea.* In India only two recognizable species viz., *B. glabra* and *B. spectabilis* are met with. Special attention has been paid on the occurrence of several well defined varieties. Karyotype analysis has been performed with the aid of improved techniques, involving the use of Paradichlorobenzene as a pretreatment chemical. Chromosome number in all the varieties, has been found to be 2n-34, excepting three varieties, where 2n-51 chromosomes have been recorded, suggesting the latter to be a triploid form. Varieties constantly differ with respect to minute details of the karyotypes. Structural variations of chromosomes have been noted in the somatic tissue and in view of ineffective sexual reproduction their importance in the origin of different varieties through vegetative reproduction has been emphasised. The occurrence of both 20 and 34 chromosomes in the species *'glabra'* and absence of 20 chromosomes in any other species or variety is a matter of interest. High degree of meiotic abnormalities together with the absence of seeds in the cultivated forms may suggest the intermixture of different genomes in their complements.

186. Cytology of *Boerhaavia Repens* L.

ARUN KUMAR SHARMA and UPENDRA CHANDRA BHATTACHARYYA, Calcutta.

The paper reports the cytological observations on *Boerhaavia repens*, a member of the family Nyctaginaceae, growing wild in the plains of India. Paradichlorobenzene as a pretreatment chemical and temporary orcein squash method were found to be suitable for chromosome analysis. The somatic chromosome number of the species reveals the 2n number as 94. The chromosomes are in average small and size difference gradually merges one into the other. Most of them are with median constrictions and secondary constrictions have been noted in eleven pairs of chromosomes. The high number of chromosomes together with the absence of regular occurrence of bivalents and any multivalents suggest their possible allopolyploid constitution of the chromosome complement. On the other hand, it is also likely that its herbaceous nature, high number and short size of the chromosomes may indicate its advanced status. A thorough search on different individuals growing in different parts of India is necessary to ascertain its constitution, whether it is diploid or polyploid.

187. Cytological studies on three species of *Oxalis*.

ARUN KUMAR SHARMA and TAPATI CHATTERJEE, Calcutta.

A cytological analysis of three different species of the genus *Oxalis* has been carried out. The following are the names of the species investigated: *Oxalis acetosella* Linn. (2n=30); *Oxalis corniculata* Linn. (2n–48); *Oxalis purpurata* Facq. (2n=28). In view of the previous and present data, it appears that both aneuploidy and polyploidy had played a significant role in the evolution of species. The presence of different levels of polyploidy in the plains and the hills show that polyploidy is possibly associated with an increase in the tolerance range of the temperature of the environment in which the plant grows. Meiosis so far studied is found regular and no multivalent formation was noted which suggests its allopolyploid constitution. The occurrence of individuals with aneuploid chromosome number as well as the presence of varying chromosome numbers in the somatic tissue show that possibly this is a mode of speciation in this group and the different numbers are propagated through vegetative reproduction.

188. A Cytological Analysis of the Response of Plant Tissue to certain Chemicals.

ARUN KUMAR SHARMA and MANDIRA CHAUDHURI, Calcutta.

A comparative study of the effect of some polyploidizing agents such as chloral hydrate, caffeine, acenaphthane and gammexane on young roots of *Lens esculentum* was made. The abnormalities produced with chloral hydrate were erosion, fragmentation, diplo-chromosomes and polyploidy. In treatment with caffeine sticky chromatid bridges, lagging and unequal separation were noted. With acenaphthane the most prominent effect was stickiness, other abnormalities being diplo-chromosomes, polyploidy and multipolar arrangement. Gammexane was found to induce polyploidy after a comparatively short period. Stickness, diplo-chromosomes, contraction and erosion was also noted. A distinct subnarcotic zone for all the chemicals has been worked out. A thorough analysis of the results indicates that of all the four chemicals gammexane, which can induce polyploidy within a very short period is the most effective. Temperature has a marked effect in the experimental results. Gammexane is more effective in room temperature whereas best results have been obtained with chloral hydrate and acenaphthane in cold temperature. Caffeine shows extreme effect in this respect causing lethality in room temperature. Such differential behaviour suggests that the mode of reaction is not the same in all the chemicals tried.

189. A Study of the Fate of Artificially Induced Polyploid Tissue Following Gammexane Treatment.

ARUN KUMAR SHARMA and MANDIRA CHAUDHURI, Calcutta.

The present investigation deals with the cytological study of the behaviour of the gammexane treated roottip of *Allium cepa*, after the induction of polyploidy. Saturated, ·50, 0·25 and 0.125 concentrations were tried. With the saturated solution polyploidy was noticed within 24 hours but further treatment caused lethality. 0·50% solution was also found to be lethal but the time required was more than in the case of the saturated solution. 0·25% dilution was the most effective. With the gradual increase in time, very high degree of polyploidy was noticed. Reduction was induced in polyploid cells resulting in multipolar arrangement and multinucleate cells. With recovery, the abnormalities became fewer and the normal chromosome number was restored. In the case of 0·125% concentration the most striking result was that, after treating for several days the cells gradually reverted to the normal condition while laying in the solution itself. After a certain level of polypoidy no further increase in chromosome number was noted and gradual return to normal condition is effected. This indicates that there must be a threshold point for the incidence of polyploidy. The return to normal condition does not only occur in Knop's solution but in the gammexane solution as well. This can be explained by assuming that the tissue gradually becomes immune to gammexane effect.

190. Chromosome breaking ability of plant pigment.

ARUN KUMAR SHARMA and ARATI MAJUMDAR, Calcutta.

The effect of green, blue-green and yellow green algal pigments as well as chlorophyll from higher plants on the roots of *Allium cepa* was studied. An analysis of results with different algal pigments revealed the chromosome breaking ability of all of them. Typical subnarcotic reactions were noted in all cases. Erosion, fragmentation, formation of polyploid nuclei, multipolar configurations, multinucleate cells as well as somatic reduction of diploid cells were frequently noted. It is evident that return to normal condition is facilitated by the formation of multinucleate and multipolar cells as well as reductional separations of chromosomes. In all cases multipolars and multinucleates are mainly found in new roots. Pigments of Chlorophyceae have been found to be the most effective with regard to fragmentation. With Cyanophycean extract, polyploidy is more rapid as compared to the rest. This indicates that its subnarcotic zone is shorter than the others so that the narcotic effect is induced early. With Xanthophycean pigments the effects ,though present, are not pronounced. A detailed work in this direction is in progress in this laboratory.

191. Karyotype Study of seven different varieties of *Litchi chinensis*.

ARUN KUMAR SHARMA and ARATI MAJUMDAR, Calcutta.

A detailed study of the somatic chromosomes of seven different varieties of *Litchi chinensis* has been carried out with the aid of Aesculin pretreatment method, viz. Muzaffarpur, Bombay, Green, Country, Muragachha, Bedana and Rose-scented. The normal chromosome number has been found to be 2n=30 in all, except in Bedana variety where it is 2n=32 and in Muzaffarpur variety where the somatic number is 28. Varieties have been found to differ with respect mainly to the position and number of secondary constrictions in the complement. Minute karyotypic differences in chromosome complements noted between difference varieties of *Litchi chinensis* emphasizes the role of chromosomal changes in the evolution at an intraspecific level. The variation in chromosome number encountered in the somatic tissue may possibly account for the origin of these differing varieties through their participation in the formation of germ cells.

192. Further investigations on the Cytology of some members of Aroids.

ARUN KUMAR SHARMA and DIPTI MUKHERJEE
(née BHATTACHARJEE), Calcutta.

The present investigations deal with chromosome studies of nine species of Aroids belonging to four genera under different tribes. The propagation of all these species is carried out principally through vegetative means. For the study of the details of chromosome structure, new techniques, involving the use of paradichlorobenzene have been resorted to. Ths is a continuation of the work already undertaken in this Laboratory. Flowering is rare, and as such, meiosis has been presented in one species only. The chromosome numbers of different species counted are :—(1) *Lasia heterophylla* Schott., 2n=26. (2) *Homalomena elliptica* Hook. f., 2n=42. (3) *Colocasia affinis* Schott., 2n=28. (4) *Alocasia putii*, Gagnep., 2n=28. (5) *A. lindenii.*, 2n=56. (6) *A. argyreia.*, 2n=56. (7) *A. macrorrhiza* Schott., 2n=28. (8) *A. navicularis* C. Koch & Veitch., 2n=68. (9) *A. zebrina* C. Koch & Veitch., 2n=28.. Detailed karyotypes of each species have been worked out and different types of chromosome complements have been noted with varying number of secondary constrictions. Role of structural alteration of chromosomes and polyploidy in speciation has been pointed out. A characteristic feature noted in all the species, is the occurrence of variation of chromosome complements in the same somatic tissue of an individual. With the help of available evidences, it has been shown, that somatic variations play an effective role in speciation through their entrance into the growing regions of daughter shoots. Lines of evolution as would be traced from the cytological data, have been delineated. The species of *Alocasia*, except *A. navicularis*, show multiples of 7 chromosomes in their complement. *A. navicularis*, with 2n=68 chromosomes probably represents a derivation from one of the members of the polyploid series. The genus *Alocasia*, as far as their number, morphology, and size of the chromosomes show, seems to represent quite a natural assemblage and all the species so far investigated, represent the same evolutionary series. It has been assumed, that *Lasia* shows affinity to the same evolutionary line as represented by species of *Alocasia*. Cytological observations in *C. affinis* do not justify the inclusion of the genus *Colocasia* along with *Alocasia* under the same tribe Colocasieae. On the basis of the previous and present data, the genus *Homalomena* has been considered as not representing a natural assemblage.

193. Karyotype studies of some members of the family Iridaceae.

ARUN KUMAR SHARMA and ARCHANA SHARMA (née MOOKERJEA)
Calcutta.

A detailed study of the chromosome structure has been carried out on seven different species and varieties of Iridaceae belonging to four different genera, namely, *Tigridia, Moraea, Tritonia* and *Babiana*, with the aid of aesculine pretreatment. The chromosome numbers noted vary from $2n=14$ to $2n=60$. Clear evidence of karyotype difference between species to species has been worked out. Evidence of polyploidy in *Tritonia crocata* ($2n=20$ and 60) has been indicated. The record, taken in conjunction with the previous one, shows that the basic set in *Babiana* is possibly represented by $n=7$ chromosomes. Variation in the chromosome complement noted in the somatic tissue may have some significance in speciation, aided through vegetative means.

194. Cyto-taxonomical studies on some members of the Iridaceae with special reference to the structural heterozygosity of *Cipura paludosa*, Aubl.

ARUN KUMAR SHARMA and CHITRA TALUKDAR, Calcutta.

The somatic chromosome number of the different species and cytotypes are as follows :—

(i) *Belamcanda chinensis* Leman. $2n=32$.
(ii) *Eleutherine plicata* Herb (l.c.) $2n=14$.
(iii) *Cipura paludosa* Aubl.—type I from Calcutta $2n=12$.
(iv) *Cipura paludosa* Aubl.—type II from Sikkim $2n=12$.
(v) *Cipura paludosa* Aubl.—type III from Santiniketan $2n=12$.
(vi) *Cipura paludosa* Aubl.—type IV from Calcutta $2n=13$.
(vii) *Cipura paludosa* Aubl.—type V from Sikkim $2n=14$.

Cipura paludosa with its five cytotypes has two very long chromosomes, which form a heteromorphic pair. In all of the cytotypes, only two chromosomes bear secondary constrictions, excepting type 5 where three pairs of chromosomes have secondary constrictions. In addition to the normal plates, those showing both structural and numerical variations have been observed. Correlation to some extent of the cytotypes and their ecology have been worked out and the scope of investigation has been emphasized. The origin of the cytotypes have been assumed to have taken place through various chromosomal aberrations in the somatic tissues and their subsequent participation in the formation of daughter shoots by vegetative propagation. The three species, *B. chinensis, E. plicata* and *C. paludosa* show two distant lines of evolution, one containing *B. chinensis* which stands in marked contrast with reference to its cytological and morphological characteristics from the one containing *E. plicata* and *C. paludosa.*

195. Study of the somatic chromosome of the genus *Aristolochia.*

ARUN KUMAR SHARMA and BASUDEO VARMA, Calcutta.

A cytological investigation of the following five species of the genus *Aristolochia* has been carried out. The names of the species are : *Aristolochia indica* Linn., *A. elegans* Mast., *A. cymbifera* Mart. and Zucc., *A. grandiflora* Sw., and *A. ridicula* N. E. Brown The chromosome number for all the species investigated is $2n=14$, except for *A. indica* Linn., it is $2n=12$. A detailed karyotype study of all the species investigated, reveals a gross structural similarity in their chromosome complement, showing that they form a natural homogeneous assemblage. However, the presence of both numerical and structural difference in the karyotypes between different species indicate that minute structural alteration of chromosomes have been responsible for the evolution of species. *A. indica* Linn., having the lowest number ($2n=12$) and only one pair of chromosomes with secondary constructions, probably represents the most primitive species of those studied here. Somatic nuclei, with chromosome numbers other than the normal one, have been noted. Their role in evolution needs further researches.

196. Study of the effects of chemicals on endosperm chromosomes of *Cestrum Diurnum* Linn.

ARUN KUMAR SHARMA and BASUDEO VARMA, Calcutta.

The investigation on effects of chemicals on endosperm nuclei was carried on the plant, *Cestrum diurnum* Linn. Saturated, half-saturated and quarter saturated solutions of Resorcinol, Pyrogallol, Phloroglucinol and 8-Hydroxyqunoline in distilled water were injected below the main stalk of the flower clusters and period of treatment was varied with varying concentrations. The period of treatment varied from one hour to tenty four hours. The general effect was the production of stickiness, fragmentation of chromosomes, resulting into the lethality of the twig. Of all the chemicals tested, 8-Hydroxyquinoline had less toxic effect, while Pyrogallol and Resorcinol had high toxic value. Polyploidy noted in certain cases after Pyrogallol treatment showed the presence of narcotic effect. Subnarcotic and lethal effect too in endosperm nuclei was recorded. With Phloroglucinol, lethality was the final result of treatment though death of the twig did not result instantaneously. It was brought about gradually in prolonged period. With low concentration and short period of treatment, more time was taken by the twig to reach lethality and with the prolonged treatment, the toxicity caused was comparatively rapid. In general, fragments of the chromosomes were not observed in any concentration following one hour treatment, while with prolonged period of treatment of three hours, five hours and twenty four hours, increasing amount of fragments was observed. This may indicate that a definite amount of fluid level within the cell is required to cause fragmentation of chromosomes. The effect of chemicals tested here on endosperm nuclei differed from effects of these chemicals tested on roots by other workers, indicating thereby differential cytoplasmic constitution of the different organs may account for their behaviour.

197. Polyploidy and speciation in the genus Aeschynomene.

M. G. SRIVASTAVA, Calcutta.

Three species of *Aeschynomene,* two of them namely *Ae. indica* and *Ae. aspea* L., being the sole representatives of the genus in the Indian flora, and an American species (*Ae. americana*) have been taxonomically described.

The mitosis and meiosis in the three species have been studied in detail and they have been found to be fairly stabilized. The few abnormalities recorded have been briefly discussed.

The chromosome numbers of the 3 species have been determined to be as follows :

Ae. americana	$2n = 20$
Ae. aspera	$2n = 36$
Ae. indica.	$2n = 40$

Those for the first two species are reported for the first time.

The degree of polyploidy in the species has been worked out on the basis of the number of nuclei and the basic number of chromosomes. The role of polyploidy in the geographical distribution has been discussed. It has been suggested that the polyploidy has perhaps been induced in response to the migration from cooler to warmer habitat.

On the basis of the Karyotype analysis, the nature of polyploidy in the species has been discussed. It has been found that whereas the karyotype of *Ae. indica* is a simple duplicate of *Ae. americana,* the constitution of the complement of *Ae. aspera* is heterogeneous. Thus the presence of an element of some unknown species has been pointed out and an allopolyploid origin has been ascribed to the species.

Finally, the speciation in the genus in the light of the evidences from polyploidy, hybridization and structural change in the chromosomes has been discussed.

It has been tentatively concluded that there exist at least two different lines of evolution in the genus; one arising as a result of simple multiplication of chromosomes or autopolyploidy as in *Ae. indica* and the other involving hybridisation or allopolyploidy as in *Ae. aspera.*

198. Cyto-taxonomy of *Prionotes cerinthoides* R. Br.

C. VENKATA RAO, Waltair.

Prionotes cerinthoides R. Br. belonging to Epacridaceae, is a monotypic endemic which inhabits the rain forests of W. Tasmania. Epacridaceae is divided by Bentham and Hooker into two tribes : the Epacrideae (carpel multiovulate, fruit capsular) and Styphelieae (carpel uniovulate, fruit drupaceous). Engler and Prantl constituted *Prionotes* and *Lebetanthus* (monotypic S. American endemic) into a third tribe *Prionoteae* (stamens free from petals). Skottsberg (1915) suggested merging *Lebetanthus* with *Prionotes* and transferring the latter to the Ericaceae.

Prionotes shows a haploid chromosome number of 26. Though several genera of the Epacrideae have $n=13$, *Epacris serpyllifolia* has $n=26$ (Smith White, 1955).

The wood of *Prionotes* is diffuse porous. The vessels are narrow, elongated and show tapering ends and scalariform pits. The vascular rays are uniseriate and homogeneous. The leaf trace is unilacunar. In several of these features, *Prionotes* resembles other Epacrideae (Copeland, 1954).

The flowers of *Prionotes* resemble those of *Richea* and *Sprengelia* in inconspicuous nectaries and absence of adnation of stamens and petals. The pollen grains are in tetrads. The anthers are 2-locular and each loculus opens by a separate longitudinal slit. In these features, *Prionotes* stands out distinctly from the Ericaceae in which the anthers are 4-locular and the dehiscence usually poricidal.

The ovules of *Prionotes* are unitegmic and tenuinucellate. The embryo sac develops according to the normal type, and borders on the endothelium.

The present studies lend little support to Skottsberg's suggestion of transferring the genus to the Ericaceae. Since *Prionotes* does not show a single distinctive feature which justifies its separation into a tribe, the writer feels that it should be retained within the tribe Epacrideae.

199. Genome Sensitivity of Wheat to Radiation.

R. A. PAI, New Delhi.

In a comparative study of the effects of radiation on the somatic chromosomes of diploid, tetraploid and hexaploid wheats, it was found that the chromosomal aberrations occurring in hexapolid wheat far exceed the number expected on the basis of total chromatin length. It was thought that this increased sensitivity of the hexaploid wheat which is an allopolyploid comprising of three different genomes that is A, B and D over the tetraploid having A and B genomes and diploid having A genome may be due to the addition of D genome at hexaploid level. The present study was undertaken to determine whether the D genome is responsible for the increased radiosensitivity of the hexaploid wheat and also to have a comparative data on the radiosensitivity of the other two genomes namely A and B.

Triticum monococcum (A genome) *Aegilops speltoides* var. *ligustica* (B. genome) *Aegilops squarrosa* (D genome) along with species of *Aegilops Agropyron* and other related genera like *Hynaldia* of Triticinae group were subjected to different dosages of X-rays. By studying the mutation spectrum, especially the chlorophyll mutations in these species of *Triticum, Aegilops, Agropyron* and *Hynaldia* it is possible to get an idea of the mutability rate of the different species of the different genera which may in turn throw some light on the sensitivity of the different genomes of bread wheat.

200. Effect of Polyploidy on the Radiosensitivity of Wheat and Barley to X-rays and Neutron Radiation.

S. BHASKARAN, New Delhi.

The relation of polyploidy to radiation effects in 2X, 4X and 6X wheats belonging to an allopolyploid series and 2X and 4X Barley of autopolyploid series was extremely studied. Dry seeds were irradiated with different doses of X-rays ranging from 5000r to 50000r in increments of 5000r, and fast neutrons of source strength 10^9nf/sq. cm./sec. for 3, 5 and 6 hours. Following analyses were carried out: (1) *Germination and growth.* The tolerance increased as polyploidy increased. There was a straight line relationship between radiosensitivity and chromosome number. (2) *Nucleic acid (DNA) synthesis.* The measurement of DNA is a sensitive measure of radiation damage to a rapidly proliferating tissue. DNA measurements of root-tip nuclei stained with Feulgen reaction, showed an inhibiton after irradiation. But the percentage reduction of DNA synthesis did not follow the straight line relationship between radiosensitivity and polyploidy in the wheat series whereas in barley, the percentage reduction in tetraploid was found to be double to that of diploid.

(3) *Cytological effects*: Cytological analysis of chromosome aberrations in mitotic cell divisions in the root-tips were carried out. A larger fragment frequency was observed in hexaploid wheat when calculated as number of fragments per chromosome. In barley no such difference could be demonstrated.

The above results indicate that the relationship between polyloidy and radiosensitivity might vary with the kind of polyploid used. However, in general it may be concluded that polyploids are more tolerant to radiation damage probably due to the buffering effect of extra genomes.

201. Effects of some vegetable and mineral oils on mitosis in *Allium cepa. Vicia faba. Nicotiana tabacum.* and *N. rustica.*

K. A. PATEL, New Delhi.

In continuation of an earlier report from our Laboratory on the chromosome breaking ability of vegetable oils and edible fats on diploid wheat (Swaminathan and Natarajan, 1956), standard *"Allium test"* (Levan 1949) was conducted in the following (a) *vegetable oils*: Groundnut oil, castor oil, olive oil, mustard oil, gingelly oil, linseed oil, coconut oil and sersave oil; (b) *mineral oils*: Shell 100 and diesel oil and (c) 4 fractions of groundnut oil and two fractions of castor oil, for two durations of treatment i.e. 4 hours and 24 hours, and after treatment the roots were washed and grown in tap-water. Morphological changes in the root growth were recorded and the root-tips were fixed in acetic-alcohol immediately, 24 hours, 48 hours, 72 hours, 120 hours and 168 hours after treatment and the root tip mitosis were studied by Feulgen squashes. Visible small tumours were found to develop in the roots of treated material. In the root tip meristem, apart from certain Physiological effects like, plasmolytic changes in the cytoplasm and nucleus clumping, sticky bridges etc., many interesting cytological effects like, chromosome breakage, chromatid breakage, formation of minutes and rings at metaphase, bicentric bridges, acentric fragments, error bridges, unequal distribution of chromosomes, reductional mitotic groups, laggards at anaphase, spindle abnormalities like tripolar spindle and polyploidization of cells were recorded. An interesting feature of the treatments was the extreme contraction of chromosomes at metaphase and exaggeration of primary and secondary constrictions of the chromosomes.

Seeds of *Vicia faba, N. tabacum* and *N. rustics* were also treated with the above oils and fractions and similar results were recorded; from the percentage of aberrent cells, it was found that both the groundnut oil and castor oil were very effective. To determine which fraction of these oils is most effective, four fractions of groundnut oil and two fractions of castor oil were used. These fractions in the case of groundnut oil comprised of components of least soluble, intermediate, and most soluble mono, di, and tri-saturated and unsaturated glycerides ranging in different proportions in respective fractions. In the 4 hours treatment fresh groundnut oil and first fraction were most effective, and in 24 hours treatment fractions 2, 3 and 4 were effective, 3 and 4 being more potent than fraction 2. However there were complete inhibition of cell division and denuclination of cells, in first fraction and fresh groundnut oil, indicating that they are more effective than fractions 2, 3 and 4. In castor oil, however, both the fractions were found to be inducing chromosomal changes.

202. Chemical induction of pollen sterility in wheat, tomato and onion.

V. L. CHOPRA, New Delhi.

Studies were undertaken to standardize a suitable technique for causing the selective abortion of pollen grains in tomato, onion and wheat. A wide range of concentrations of Maleic hydrazide, Sodium nucleate, Nucleic acid, Thymine, Uracil and Tri-iodobengoic acid were tried for this purpose. Meiotic irregularities in wheat plants treated with MH include presence of varying number of univalents at MI, unbalanced chromosome number, complete lack of synchronization in chromosome movement at first anaphase resulting in lagging univalents and bivalents, chromosome fragmentation and stickiness. Irregularities of meosis in onion include asynapsis and desynapsis caused by nuleic acid and maleic hydrazide respectively. Sodium nucleate, besides disturbing normal chromosome pairing in about 90% of the microsporocytes, produced polyploidy, stiickiness and suppression of second division.

Maleic hydrazide induced complete pollen sterility in tomato with 50 ppm., sprayed twice and 100 ppm., sprayed once or twice, in treatments made before the opening of first flower. Tomato plants when treated before opening of second flush flowers, however, required relatively higher concentration viz., 200 ppm. sprayed twice, for producing complete pollen sterility. The seed-setting capacity of the fruits on treated tomato plants, during the period of complete sterility, was not impaired to any considerable extent; the maximum percentage of reduction in seed set associated with complete sterility being 18·4.

In wheat, 250 ppm. of Maleic hydrazide induced complete pollen sterility when the chemical was sprayed once or twice before the flag leaf emergence; 250 ppm. sprayed 3-4 times or ppm. sprayed once or twice during flag leaf emergence. In onion, all the chemicals tried gave complete sterility at the various concentrations used.

A comparison of the results obtained during 2 years, reveals that, barring small differences which could be ascribed to environmental fluctuations, the effects of the particular concentration in inducing sterility may be reproducible. Thus, there is a distinct possibility for standardising a technique for the selective abortion of pollen grains in several plants.

203. Identification of genes on Chromosomes in wheat through monosomic analysis.

M. P. SINGH, New Delhi.

The use of monosomics, 2n-1 plants, for cytogenetical studies and for transference of desirable characters by substituting particular chromosome has become —an important part of the cereal breeding programme in several countries. In 1954 a complete set of 21 monosomes of the wheat variety "Chinese Spring" was obtained from Dr. E. R. Sears of the Missouri Experiment Station, United States. Crosses were made between plants monosomic for a particular chromosome in each of 21 lines and black, brown and yellow rust differentials. The resistant differentials used were Kenya C. 10854 (E. 220) for black rust, Aio Negro (E. 952) for brown rust and Cometa Klein (E. 671) for yellow rust. During 1954-55, the cycle of crosses could be completed only with Cometa Klein, originally obtained from Argentina and is resistant to the Indian yellow rust races 13, 19, 31, A, D, E, G, F and N.

During the rust reaction studies of these 21 substitution lines (At Wheat Breeding Substation, Tutikandi, Simla) with races II and 13, it was found that only three chromosomes of Cometa Klein show resistance as dominant at seedling stage. In order to have complete check and confirmation of results, with each set of seedlings "Agra Local", a highly susceptible variety, normal "Chinese Spring" susceptible female parent and Cometa Klein, the resistant male parent was also inoculated with the same race under the same condition of temperature and humidity. From the observations in the study of second generation in Dec. 1956 and January 1957, after final recording, it was evident that Cometa Klein carries two complementary genes for race II in chromosomes IV and VI and a single dominant gene for race 13 in chromosome IX. This dihybrid ratio of 9 :7 and monohybrid ratio 3 :1 gave good fit in all other lines except the critical monosomic lines where chromosomes IV, VI and XI were involved, thus confirming the observations.

AWN EXPRESSION

The Chinese wheat is awnless and Cometa Klein is fully bearded. While all F_2 plants were slightly tipped, there was segregation for and development in lines involving chromosomes III, VIII and X. All the awned F_1 plants in lines III, VIII and X were found to be monosomes, the disome being slightly tipped. These observations have been confirmed in F_2 and F_3 and from the results it is inferred that Cometa Klein carries the following factors in the chromosomes mentioned : (a) a recessive gene "a" for awn development and possibly some factors for chromosome synapsis in chromosome III. (b), a recessive allele of awn suppressor genes, Hd. and B_2 in chromosome VIII and X, respectively.

204. Studies in the induction of Mutations in Cotton and Wheat.

D. JAGATHESAN, New Delhi.

Induction and isolation of econmically useful mutations in wheat and cotton are the main objectives of the mutation research programme in progress at the Division of Botany, IARI New Delhi. The varieties used in the study are N.P. 799, N.P. 809 and C. 591 in Wheat and H-14, 216F, 320F and Mescilla acala in *G. hir-*

sutum, BLR 14/16 Domain sakel and S.I. Montessort in *G. barbadense*, Guorani-12, K1 and K2 in *G. arboreum* and Hgari-1 in *G. herbaceum*. The different physical mutagens such as β-rays, X-rays, thermal neutrons, ultra-violet rays, infra-red rays were used either alone or in combination with one another in order to find out the efficiency of these radiations in inducing mutations. Pretreatments with several chemicals like MH, colchicine were also included with a view to study the effect of combinatons of these on the mutation spectrum.

A detailed study of the phenotypic changes, pollen fertility, seed fertility and various cytological aberrations induced by these mutagens was made during the year of treatment. In the X_2 generation many interesting variations and economically valuable mutations such as fully bearded plants from a beardless variety, monosomes, nullisomes, speltoids, compactoids, erectoides, high-tillering plants and plants with better grain quality were isolated. The different nullisomes and monosomes were identified and cytologically studied. Many of these variants have been found to be heritable and the genetics of these mutations are being studied.

In cotton one jassid resistant plant in Mescilla acala, a variety usually highly susceptible to jassid attack, was isolated in X_2 plants treated with 48000r of X-rays In 320F, a late variety, one early flowering and early maturing plant was isolated. This plant was early by about 20 days than the control. The results will be discussed with reference to the relationship between polyploidy and radiosensitivity.

SECTION OF ZOOLOGY AND ENTOMOLOGY

President :—B. S. BHIMACHAR, D.Sc., F.N.I , F.A.Sc.

Abstracts.

I. CYTOLOGY

1. Observation on the chromosome elimination in a Pyrrhocorid Bug *Macroceroea (Lohita) Grandis* (Gray).

M R. BANERJEE, Calcutta.

An interesting case of fragmentation of the X-chromosome and subsequent elimination of the extra-fragments has been observed in *Macroceroea* (Lohita) *grandis* (Gray), a species of the family Pyrrhocoridae of Hemiptera : Heteroptera. The species has a basic diploid number of 15 chromosomes with XO sex chromosomes in males. A fluctuating number of chromosomes has been observed in the spermatogonial metaphase and primary spermatocyte cells. This variation in number of chromosomes is effected by a fragmentation of the single X-chromosome in males. The extra-fragments are eliminated at the first anaphase of meiosis. All the secondary spermatocyte cells have 8 chromosomes and there are 7 autosomes and a single X-chromosome. The single X is the smallest of all the chromosomes. The behaviour of the chromosomes in the subsequent stages of meiosis is typically heteropteran. The diploid chromosome number in oogonial cells of the females is always 16 with XX sex chromosomes. No variation in the chromosome number has been observed in the females.

The exact genetic nature of the eliminated fragments, the reason for the elimination taking place at the spermatocyte division and not in the spermatogonial stages, the restriction of fragmentation and elimination to the males only and the mechanism of the recurrence of the fragments in each generation after they are eliminated, have been discussed in the paper.

2. Some histological and histochemical observations on the uropygial gland of pigeon.

M. DAS and A. GHOSH, Calcutta.

The present report concerns the histology and chemical cytology of the uropygial gland of pigeon. This gland was investigated for the presence of cytoplasmic basophilia, lipids, ascorbic acid, phosphatases, proteins and hexose-containing substances. Histologically, the uropygial gland is multiple acinar, and holocrine from the standpoint of the nature of cellular damage. The whole gland is encapsulated by a layer of connective tissue, with blood vessels embedded on it. In general, four types of cells are noticeable in each glandular acinus.

Indifferent cells are peripheral in position and rested on an acinar basement membrane. The cells are flat with basophilic cytoplasm and compressed nuclei. Abundant basophilic substances and xanthoproteic-positive materials appear in these cells. Any appreciable amount of alkaline phosphatase is also discernible.

Moderately differentiated or intermediate cells are characterized by their round to oval shape with granular basophilic cytoplasm and round nuclei. The presence of ascorbic acid in these cells is also noted

Differentiated central cells are large polyhedral cells with vacuolated cytoplasm and prominent vesicular nuclei. These cells contain lipid droplets which are practically unstained with sudan black B, but are stained clearly with sudan III and IV. Only a negligible amount of reactive substances is shown and basophilic materials are absent in these cells. However, a moderate amount of alkaline phosphatase is encountered in the central cells only.

Luminal cells are scale-like in appearance, with vacuolated cytoplasm and pyknotic nuclei. Cytoplasmic pattern of these cells closely resembles that of the central cells. The presence of PA-Schiff positive material at the luminal edge of these cells is shown.

The luminal secretory material contain cellular debris, large quantities of sudan-positive materials and small amounts of PA-Schiff reactive substances and alkaline phosphatase.

The possible significance of these reactive substances in normal holocrine cycle of this sebaceous type of gland has been pointed out and discussed. The results of the present study also suggest the probable chemical composition of the final secretory product of this gland, and there are reasons to conclude that the "avian sebum" is mainly composed of unsaturated trigly-cerides and alcohol-resistant sudanophilic lipids with a trace amount of hexose-containing polysaccharides and alkaline phosphatase.

3. Studies on the nucleic acids in *Colpoda cucullus*.

G P. DUTTA, Jullundur City.

Colpoda cucullus reveals a small micronucleus attached to a large, rounded macronucleus. The macronucleus reveals a coarse net-work of DNA and also shows a number of large Feulgen negative spaces. These spaces are rich in RNA. The micronucleus shows the presence of both DNA and RNA. The pyronin/methyl green staining shows that the micronucleus is very rich n DNA, whereas the macronucleus contains more of RNA. In addition to the nuclei, the RNA is present in the cytoplasm and the mitochondria.

4. Studies on the nucleic acids in *Balantidium helenae*.

G. P DUTTA, Jullundur City.

Balantidium helenae, which is a parasite in the gut of frog, reveals a macronucleus which is kidney shaped and a small rounded micronucleus. The cytoplasm reveals the mitochondria, lipid bodies, and some protein globules in addition to the carbohydrate material. The mitochondria are composed mainly of proteins and phospholipids. The cytoplasm is rich in glycogen.

The macronucleus is rich in DNA and shows certain Feulgen negative spaces. These spaces are stained with pyronin and are digested by the salivary ribonuclease, showing that they contain RNA. The micronucleus is rich in both the DNA and Rna. The so-called protein globules contain DNA and RNA. The mitochondria contain a large quantity of RNA, whereas the basiphil cytoplasm shows a weak positive reaction.

5. A cytological study of the post-embryonic development of the alimentary tract in *Lygaeus kalmii angustomarginatus* Parshley.

C. MARY JOHN, Trivandrum.

The tubular stomadaeum in *Lygaeus kalmii angustomarginatus* has flattened epithelium which remains diploid throughout life The mesenteron is divided into the first to the fourth ventriculi and the epithelium is columnar formed of large polyploid digestive cells and small, mostly diploid, regenerative cells. The proctodaeum consists of an ileum and a rectum; the epithelium of the former is columnar while that of the latter shows two regions, a squamous with polyploid cells and a columnar composed mostly of diploid cells.

Well defined valves are present; the stomodael, first ventricular, second ventricular, third ventricular, pyloric, rectal and anal valves. Regenerative zones are present in the vicinity of some of the above valves.

In the early first instar, the mesenteron and the proctodaeum are formed of diploid to 16-ploid cells. From the second instar onwards, the mesenteron shows 32-ploid cells with no further increase in polyploidy. The polyploidy of the squamous regions of the rectum reaches the highest degree, 256-ploid, in the late fourth and early fifth instars. In the imago, the same layer is at most 128-ploid. The largest cells of the epithelium of the ileum are 64-ploid in the early fifth instar and in the imago the same degree of polyploidy is found.

There is no complete destruction of any region of the alimentary tract, but as in holometabolous insects, at the posterior and anterior ends of the foregut and hind gut respectively there are two clearly marked regenerative zones which function throughout nymphal life.

The nuclei of the alimentary canal are generally more deeply staining in the late instars. Mitotic figures were never seen in any region throughout the post-embryonic development. Growth seems to be due to an increase in the size of the individual cells resulting from endomitosis and an increase in the number of cells by amitosis. In polyploid nuclei the heterochromatic Y-chromosomes partially fuse to form a Y-chromosome complex. Binucleate cells are commonly seen, especially in and near the regenerative zones and they are in general more frequent in the growing stages and young imago. Occasionally binucleate cells in various stages of endomitosis were observed. Binucleate cells seem to be an index of the growth of the tissue by the amitotic process Since aneusomaty is present and can be tolerated by the organism in the later stages of development and hence even if amitosis does result in the unequal distribution of chromosomes between the daughter cells, the life of the somatc tissue of the organ may not be adversely affected.

6. Studies on the Cytoplasmic Inclusions in the Exocrine Cells of the Pancreas of *Uromastix hardwickii.*

KULDIP CHAND KANWAR, Hoshiarpur.

The process of zymogen secretion in the acinar cells of *Uromastix* pancreas has been studied in detail by employing, in addition to the old classical 'Golgi' techniques which have long since been proved to be highly capricious and unreliable, more rational techniques of known chemical reactions. In the cells which are in early recovery phases, the cytoplasm reveals filamentous mitochondria with surface granules (comparable with the Golgi prae-substanz of Hirsch), the latter being markedly argentophil, osmiophil, sudanophil and chromophil. These lipidal surface granules get detached from the mitochondria, grow in size, get vacuolated and finally serve as 'sites of condensation' for the secretory product which is proteid in nature. During the process of protein synthesis there has been observed a definite consumption of the enveloping lipid material which is finally reduced to thin crescentic caps seen attached to the maturing zymogen granules. Even these lipid remnants in the form of 'cresents', 'caps' or small 'rodlets' are expelled out of the cells along with the extruding zymogen granules and hence there exists no continuity of this lipid material during various secretory cycles as advocated by Hirsch and Worley.

It has also been reaffirmed that there exists nothing which could even remotely be compared with the classical 'apparato reticolare interno' of Golgi.

In the light of recent researches it has been thought useful to avoid the use of various terms like 'Golgi apparatus'. 'Golgi bodies', 'Golgi substance' and 'Golgi elements' etc.

7. Cytological studies on the Acinar Cells of Pigeon Pancreas.

KULDIP CHAND KANWAR, Hoshiarpur.

The process of protein synthesis in the acinar cells of pigeon pancreas has been worked out in detail by employing both 'rational' and 'irrational' techniques. The lipid bodies have been observed to arise from the highly sudanophil, chromophil, osmiophil and argentophil granules found on the surface of filamentous mitochondria, the latter being lipoproteinous in their nature. These filamentous mitochondria during active lipid synthesis (prior to the zymogen synthesis) become shorter and thicker and appear rod like in formaldehyde-osmium preparations and tubular with chromophilic margins and hyaline cores in Regaud preparations, stained either with iron haematoxylin or acid fuchsin. Multivacuolated lipid bodies comparable with the 'puddingstone like masses' of Worley have been observed to have resulted by the close aggregation of two or three or even four duplex lipid spheroids.

It has been re-established that there is a definite lipid consumption during the secretory genesis and there exists no continuity of this lipid material in acinar cells as advocated by Hirsch and Worley.

There exists nothing in these cells which could be compared with the 'Golgi apparatus' of so many workers.

8. Preliminary Histochemical Observations on the Oxyntic Cells of Rats.

KULDIP CHAND KANWAR, Hoshiarpur.

Oxyntic cells of common house rat and white rat have been investigated. These cells are characteristic in having alkaline cytoplasm and hence are markedly acidophilic. Oxyntic cells are larger than the peptic cells, reveal no polarity—characteristic of acinar cells, and present a coarse granular appearance. Mitochondria which are almost uniformly distributed throughout the cytoplasm exist in the form of granules and small filaments or rods, the latter with one (rarely two) end granule. Lipid bodies are of three types i.e. small granules of the size of granular mitochondria; very few duplex bodies and big spheres. The first two types are phospholipid in nature whereas the last one are lipoproteinous bodies, the lipids in these being neutral fats. These lipoproteinous bodies are distinctly stained with Hg. BPB and acid fuchsin.

These cells reveal intracellular canals and there exists nothing which could even remotely be compared with the classical 'Golgi apparatus'.

No PAS positive bodies have been encountered during the present study. No metachromasia is observed in these cells by Feyrter's enclosure method.

9. Spermateleosis in *Passer domesticus indicus.*

P. N. MEHROTRA, Ranchi.

The paper gives a detailed account of the changes undergone by the cytoplasmic inclusions as also of the nuclear changes during the metamorphosis of the spermatid into the spermatozoa in *Passer domesticus indicus.*

During spermateleosis, the golgi bodies tend to move towards the nucleus and take position just opposite the centriole; the one that reaches the nucleus first becomes attached with the nuclear membrane. The attachment of the golgi bodies to the nuclear membrane probably gives a sort of stimulus to the nucleus to elongate. No trace of the nucleus is to be seen in the sufficiently elongated nuclei.

The golgi bodies lose their lumpy appearance and in place thereof a vesicle becomes visible in the idiosome and inside this vesicle appears the proacrosomal granule which changes its form to become the acrosome. The acrosome is conical in shape and occupies the anterior tip of the head of the spermatozoa. After the formation of the acrosome the golgi material migrates to the residual cytoplasm and is eliminated as the golgi remnant.

In the mean time the centriole divides into two, the products of division at first lying adjacent to each other connected by a very fine thread-like fibril of cytoplasmic origin. One of the two centrioles now descends and lies just below the other and though both become very conspicuous, the proximal centriole is more prominent. The mitochondrial granules begin to concentrate and coalesce on either sides of the fibril and consequently their granular appearance is lost. The proximal centriole and a little cytoplasm give rise to the neck of the sperm, while the fibril along with the mitochondrial sheath gives rise to the middle piece. The distal centriole assumes a horse-shoe shaped appearance and marks the distal limit of the middle piece. The lengthening of the fibril is due to the movement of the distal centriole.

The fibril makes its way out of the limit of the cell. This portion of the fibre is without any cytoplasmic inclusions and forms the tail.

Giant sperms of more or less double the size of the normal sperms are also sometimes visible.

10. Nuclear inconsistency in Hydra.

S. MOOKERJEE and S. N. NAGARAJAN, Calcutta.

In Hydra one finds several cell types which are noted to harbour nuclei that are neither uniform in the size nor stain with the same intensity. It is also noted that a certain proportion of nuclei do not divide by normal mitosis. Certain abnormal division patterns such as arrested metaphases, amitoses etc. have been encountered.

The interstitial cells in general contain nuclei of a rather uniform kind and they always divide by mitosis. They show a granular inner structure in their resting phase.

A number of nuclei of the endoderm cells are much bigger and at the same time they are not uniform in their size but they stain amidst themselves uniformly. These are endopolyploid. No regular mitosis has been observed in their case.

The nuclei of the nematocysts stain as intensely as those of the interstitial cells, but they do not show a granular inner structure; they are never seen to divide mitotically. There have been observations that indicate amitotic patterns of division, though it is true that such divisions are rare.

The general problem of endopolyploidy has been discussed with particular reference to amitosis and tissue differentiation.

11. Effects of chemicals on the nuclei of the cells of Hydra.

S. N. NAGARAJAN, Calcutta.

Various chemicals are employed with the object of studying the somatic nuclei of the body wall of Hydra. The general feature of the nuclei (though not all) is that most of them seldom seem to divide mitotically, nor the chromosomes come to visibility, very frequently. The chemicals—3-Indol Acetic Acid, Aesculininm, Colchicine, Sodium nucleate (from Yeast and Thymus), Paradichlorobenzene were employed with the expectation of activating these nuclei.

Sodium nucleate in lower dosages effect the condensation of chromosomes though a higher dosage often prdduces flocculation leading to pycnosis. Mitosis is induced to an extent, still the chromosome counting is difficult. 3-Indol Acetic Acid is almost similar in its effects to that of Sodium nucleate, but is a better tool. Colchicine is not a mitosis-inducer. Aesculinium also produces chromosome condensation but as a mitosis-inducer it is comparatively a poor tool.

The chemicals most effective on the bigger nuclei which show a poor staining reaction (Probably endopolyploid) are Sodium nucleate and 3-Indol Acetic Acid.

12. Chromosome studies in some members of Chilopoda (Class: Myriapoda).

C. R. PUTTANNA, Bangalore.

An attempt has been made to study the process of meiosis in five species belonging to five genera of the Family Scolopendridae and one species belonging to the Family Geophilidae. The diploid number, haploid number and the sex-mechanism in the male individuals have been studied.

13. Chromosome Mechanism in the Male Scorpion (Buthidae: Scorpiones).

G. P. SHARMA and M. G. JONEJA, Hoshiarpur.

The diploid number of chromosomes is 22 in *Buthus doriae* and *Buthus sp.* and 24 in *B. macmahoni*. In all these species, the first meiotic division is reductional and is characterised by the absence of the diplotene and the diakinesis. The bivalents remain in parallel alignment throughout the prophase (excepting, of course, the leptotene) and the metaphase of the first meiotic division, there being no chiasma formation. During the early anaphase of the first division both the ends of each chromosome show equal active mobility and the chromosomes are, thus, distinctly arch-shaped. During the later stages, however, the shape of the chromosomes varies from an arch to a 'J' or a rod, due to the relative difference in the active mobility at the two ends of each chromosome. There is no apparent difference between the autosomes and the sex chromosomes, both in the mitotic and the meiotic divisions.

One individual of *B. doriae* has been found to be structurally heterozygous with respect to as many as ten chromosomes which associate into a single decavalent or a hexa- and a tetra-valent at metaphase I. A similar structural heterozygosity, involving two or three bivalents, has also been observed in *Buthus sp.* The multiple configurations arise as a result of translocations. During anaphase I, half of the elements, involved in a multivalent, go to one pole and the remaining half to the other. Since there is only the numerical reduction of the elements, forming a multivalent, which have already undergone structural reorganisation and the second division is a simple mitotic one, it becomes apparent that duplications and deficiencies pass on into the spermatozoa. Although, such a mechanism causes a great wastage on the part of the organism because of the resulting unbalanced sperms, yet it results in genetical recombinations and variations even in the absence of the chiasmata.

14. An experimental verification of the chromosome structure in *Eurybrachis* with a general consideration of the kinetochore systems in Hemiptera.

B. R. SESHACHAR, S. R. VENKATASUBBA RAO and C. M. S. DASS,
Bangalore.

In order to determine the nature of the kinetochore in *Eurybrachis apicalis* (Hemiptera-Homoptera : Auchenorrhyncha) the animals were X-rayed (150r and 300r). It was observed during anaphases of both mitotic and meiotic divisions, that the chromosome fragments produced by irradiation did not move to the poles. They were left behind in the cytoplasm and were finally lost. In addition to fragmentation, 'bridge' formation and lagging chromosomes were also observed. These facts indicated a 'localised kinetochore' condition in the chromosomes of *Eurybrachis apicalis*.

It seems fairly certain that the Hemipteran chromosomes exhibit both the 'localised' and 'diffuse' kinetochore conditions.

II. EMBRYOLOGY

15. Transport of thermal energy across the organization centre of Chick embryo.

ASOKE BOSE, Jhargram.

Experiments have been devised to study the effects of transport of thermal energy across the organization centre of Chick embryo. Suitable distances are selected in the Chick blastoderm and a red hot needle is placed. The idea is to see the thermal interference in the morphogenetic mechanism of the embryo. In the first experiment the hot needle is applied to the area opaqua and in the second series on the junction of area opaqua and area pellucida and in the last series on the area pellucida proper

All the experiments show that heat travels through the blastoderm, irrespective of the distance selected and it results in abnormal ontogenesis. The posterior portion of the embryo is always akin to be more susceptible to the thermal energy than the anterior ends. Notochord is often missing, particularly at the posterior portion. The neural tube is mostly unclosed. The eye cup-lens induction often fails and at times the bilaterality of eye formation suffer. Among the different cell layers the ectoderm is more susceptible to thermal energy. The mesodermal cells come next in their heat sensitiveness; endoderm last.

In heat treated embryo, the morphogenetic movements are deviated and normal ontogenesis can not result.

16. Role of mouse kidney grafts on early *Xenopus laevis* eggs.

S. K. BRAHMA, Calcutta.

There does not seem to be any report on the effect of the heterologous inductor mouse kidney, on Anuran eggs. Experiments were carried out with fresh and ethanol fixed mouse kidney on early Xenopus eggs.

The results suggest that fresh mouse kidney is a weak spino-caudal inductor and that the specificity of induction remains unaltered even after ethanol treatment.

17. Mitotic significance of endoderm and mesoderm of Chick Gastrula.

S. MOOKERJEE and S. ADHIKARI, Calcutta.

This is an extension of the previous work by Mookerjee and Adhikari on the relationship between the gastrulation and mitotic frequency in the embryo. Attempts are now made to evaluate the mitotic frequency in the mesoderm and endoderm regions of chick blastoderm. Previously the condition in ectoderm has been worked out.

Chick blastoderms of different ages namely 6, 12, 18, 24 and 30 hours were studied. Mitotic happenings in the endoderm and mesoderm have been mapped out. Hypoblast of the 6 hours' stage is mitotically most active at the posterior region. Incidence of mitoses falls down in the hypoblast of 12 hours' where few dividing cells have been encountered in the middle. Both endoderm and mesoderm become well distinguishable from the 18 hours' stage. From stages of 18 hours and over the mitotic preponderance in mesoderm becomes increased while in the endoderm it steadily falls.

The relative importance of the preponderance of mitosis in the endoderm and mesoderm has been discussed in terms of organization of the embryo.

18. Studies on Indian Tunicates—I. The germ cells in *Ecteinascidia thurstoni* Herdman.

S. R. VENKATASUBBA RAO, Bangalore.

The development of the gonads in *Ecteinascidia thurstoni* Herdman (Family : Perophoridae) is described. The gonads at 2mm stage of the blastozooid are seen to arise separately from their own "fundament". The development of follicle cells is also studied. It appears that the 'primary follicle' is differentiated at a very early stage even when the oocyte is still a part of the germinal epithelium. The 'primary follicle' which is in the nature of a "syncytium" shows both flat and round nuclei. It is from the flat nuclei that the outer follicle cells are derived while the round nuclei give rise to the inner follicle cells. The 'Test cells' arise by mitotic divisions of the inner follicular epithelium.

19. Microcephaly in *Gasterosteus aculeatus* (L) developed from eggs which were treated immediately after fertilization with hot and cold shock.

H. SWARUP, Saugor.

Microcephalic forms developed from the eggs of *Gasterosteus aculeatus* when the eggs were treated with hot and cold shock by immersing them in water of a requisite temperature. Most of these abnormal forms died at embryonic stages. The types of microcephaly produced are *Synophthalmia bilentica* or *Cyclopia synophthalmia, Monophthalmia asymmetrica, Microphthalmia* and *Anophthalmia.* In an advanced embryo showing monophthalmia, a lens developed on the other side. Such a self differentiation of a lens without the presence of an eye cup is not common among vertebrates. A possible explanation for the development of microcephalic forms might be given on the basis of weak secondary inductions. Such secondary effects may be responsible for the selective reductions which are sometimes seen in the head region.

20. Hypomorphism caused by abnormal gastrulation in temperature treated eggs of *Gasterosteus aculeatus* (L).

H. SWARUP, Saugor.

Freshly fertilized eggs of *Gasterosteus aculeatus* are treated with hot and cold shock. For hot shock, a temperature of 32·5 to 37° C for 5 minutes, and for cold shock a temperature of 0° C for 1½ to 2 hours were utilised. It is observed that many of the eggs thus treated show abnormal gastrulation and result in embryonic malformations. The abnormalities include the formation of (i) only anterior part of the head, (ii) spina bifida, (iii) only trunk and tail-like structure, and (iv) tail-like structure only. Actual observation of the developing eggs show two causes for these abnormalities; firstly the incomplete formation of the germ ring which results in the blastophore failing to close, secondly the extent of the rolling in of the invaginating parts which determines the extent of differentiation. Incomplete formation of the germ ring leads to deficiencies of the posterior parts of the body and the incomplete rolling in leads to reductions of the anterior parts of the body.

Both the above cases prove the fact that the process of epiboly or engulfment of the yolk by the blastoderm is independent of the process of invagination. Further, it proves the phenomenon of morphogenetic field radiating from the animal pole. The more removed the place of invagination is from the animal pole, the less is the depth of invagination and more of the presumptive embryonic materials are left behind.

III. PHYSIOLOGY

21. Effects of environmental variation on the egg laying pattern of *Bruchus sp.*

S. BANERJEE, Calcutta.

The impact of seasonal changes on the reproduction of animals is now well known. Studies have been made to analyse quantitatively the relationship of different climatic factors to egg laying habit in *Bruchus sp.* under laboratory condition. Results are presented in the following table :

Season..	Temperature.	Humidity.	No. of eggs laid.	Frequency of egg laying in minutes.	Period of development in days.	Viability.
Summer ..	90°—100°	75%	12	8	42	75%
	100°—110°	70—97%		15—18		
Rainy ..	96°—98°	87—90%	12—15	2—½	18—25	
	80°—90°	85—90%	10—15	4—6	40—60	18%
Winter ..	60°—75°	60—65%	8	14	30—40	
	50°—70°			16		

The factors of humidity and temperature on the egg laying habits are discussed.

22. Effect of pH and temperature on the stability of human chorionic gonadotrophin (HCG).

U. K. BANIK, Calcutta.

Chorionic tissue of the placenta of human being and some higher apes elaborates a gonadotrophic hormones, commonly known as human chorionic gonadotrophin (HCG). It is purified in many laboratories upto the extent of 6000 to 8000 I U per mg. of dry amorphous powder. Dried preparation of the hormone is quite stable even for two years if kept in suitable conditions. The stability of HCG in the aqueous condition for few hours or days depends on the hydrogen-ion concentration of buffer and temperature which is reported here.

As a facet of our research programme on the purification of HCG from pregnancy urine by adsorption and elution it has been found that the activity of the hormone is decreased rapidly in summer months when the urine is acidified with dilute glacial acetic acid to *p*H 3.5 at room temperatures (34°C-39°C). It is found eventually that the stability of HCG in aqueous conditions is dependent on the temperature and hydrogen-ion concentration of the buffers or solution. From this study it is now known that the hormone is less stable below *p*H 4.6 at all temperatures above 0°C. From *p*H 4.6 the hormone shows its maximum activity at 0°C and it is maintained upto a certain level of *p*H and temperature. The destruction due to higher temperature is much rapid at higher *p*H. The potency of the hormone once destroyed is not reverted to its original strength simply by shifting *p*H and temperature. This seems to show that the active group or groups in the molecule of the hormone are destroyed

23. Hydrogen-ion concentration and digestive enzymes in the gut of *Lathetic* larva.

PREM LATA BHATNAGAR, Delhi

In order to understand the factors governing host preferences and feeding behaviour of different stored grains' pests it is desirable to have information on the ability of the insects to digest and utilise the nutrients available in their respective hosts. Since our knowledge of digestion is limited to *Tenebrio* and *Trogoderma*, the study of this aspect has now been extended to *Latheticus oryzae*.

The hydrogen-ion concentration of the gut has been determined by feeding indicator-dyed flour to the larvae. The reaction of the contents of all the regions of the gut is weakly acidic (pH 5.2-6.0). Digestive enzymes in different parts of the gut have been determined by adopting both paper chromatographic and photoelectric colorimetric techniques. The midgut contains the enzymes amylase, invertase, maltase, trehalase, cellobiase, lactase, proteinase and esterase. All these enzymes except amylase show maximum activity at pH 5.5. The maximum activity of amylase occurs at pH 6.0. These enzymes are occasionally detected in the hindgut as well.

Certain other enzymes like inulase, α-galactosidase, lipase and polypeptidase are absent in the gut of the larva. It may further be noted that the invertase, present in the gut is capable of acting on sucrose but not on raffinose or melizitose. In this respect it is different from the invertase of other insects, which in most cases is a glucosaccharase and, in some a β-*h*-fructofuranosidase.

24. Nutritive value of different parts of cotton plant to *Oxycarenus hyalinipennis* (Costa).

PREMLATA BHATNAGAR and K. N. SAXENA, Delhi.

Study of digestive enzymes, tissue preferences and the composition of the food sap of *Oxycarenus* reveals (i) that the insect feeds mostly on cotton leaf and epicalyx and least on the seed; when feeding on the cotton seed it prefers to draw the sap from the hull; (ii) that leaf is richer in nutrients than the seed hull; and, (iii) that the insect possesses the enzymes to digest and utilise proteins and carbohydrates, but not fats, of the leaf and the seed. To gain further information on relative nutritive values of different parts of the cotton plants, growth of *Oxycarenus* on these parts, provided singly and in combinations, was studied.

Best growth of the insect is obtained on a combined diet of cotton leaf + seed. Addition of green boll to this combination improves its efficiency only to a slight extent. The next best diet is a combination of leaf + freshly opened boll. The diet incorporating cotton leaf + green boll is still poor since only a few individuals are able to complete their development on this diet.

Mortality of nymphs is great and their development incomplete on the following diets: cotton leaf; lint; seed, seed soaked in water, seed+water, green boll, open cotton boll; and water only. However, even partial growth of the insect is much better on the cotton leaf than on any other part of the plant.

These results indicate that neither cotton seed nor leaf nor any other part of the cotton plant can, by itself, meet all the nutritional needs of the insect. Leaf and seed together appear to satisfy all the requirements for the insect's growth.

25. Excretion of some terrestrial and fresh water leeches.

BANSIDHAR BHATT, Delhi.

The excretion of the land leech *Haemadipsa zeylanica agilis* and the aquatic leeches *Hemiclepsis marginata marginata*, *Glossiphonia weberi*, *Dinobdella ferox*, *Hirudinaria granulosa* and *Barbronia weberi* was analysed. All these leeches have been found to excrete ammonia, urea and purine bases. Uric acid, creatine and creatinine have been found absent in the excretion of these leeches. Urea ammonia ratio in the excretion of *Glossiphonia weberi* is 1 :2, whereas this ratio for the land leech *H. zeylanica agilis* is 1 :4. During hibernation, urea ammonia ratio in the excretion of this land leech changes to 1 :1 5. This ratio in the excretion of *Dinobdella ferox* differs greatly in small, unfed and free living forms and the large, well fed parasitc forms. In free living forms the ratio is 1 :8 and in parasitic forms 1 :3. Total amount of ammonia and urea excreted is less in land leeches undergoing hibernation than in active leeches. It has been observed that the amount of urea in relation to ammonia in the excretion of most of the leeches falls down after a short time the leeches are kept in limited amount of water. This may be due to breaking down of urea into ammonia. Even then it has been noticed that the amount of ammonia estimated at the end of 48 hours is less than double the amount of ammonia estimated at the end of 24 hours. This suggests that as ammonia accumulates in the limited amount of water, in which leeches have been kept, the rate of ammonia excretion falls down. This seems to help the leech to avoid the toxic effect of accumulating ammonia.

Uricotelism, which has developed in gastropods as they migrated from water to land (Needham 1935, 1938), has not been noticed in land leeches. This seems probable due to the absence of arginase in land leeches.

The results obtained show that there has not been any marked diminution in the amount of ammonia excretion with the change of habitat from water to land in the leeches of the family hirudidae, as is the case with gastropod molluscs, in which the aquatic gastropods, particularly marine forms, excrete much ammonia and terrestrial gastropods excrete little ammonia.

26. Some aspects of the histochemical studies on the oviduct of Pigeon.

K. P. CHAKRAVARTI and D. P. SADHU, Calcutta.

The paper deals with the alkaline and acid phosphatases, and RNA and DNA activities in juvenile and laying forms of pigeon. In both juvenile and laying forms the phosphatase activities remain almost the same. This similar reaction may be due to the fact that the oviducts are not intimately connected with the transformation of phosphorylated compounds.

In the laying forms DNA and RNA contents are increased very much in magnum, uterus, and vagina, while the infundibular region shows very weak reaction. Morphologically the three regions mentioned above are directly connected with the secretion of albumen, shell forming substances & mucus, while the infundibulum is only meant for receiving the egg. From the secretory behaviour it appears that the above three regions are concerned with more protein synthesis. So it is evident that D N A and R N A are responsible for protein synthesis.

27. A method for estimating the effect of after treatment temperature on the toxicity of insecticides to the larvae of *Aedes Aegypti* L. by photo-migration.

M DAS, Calcutta

The photomigration technique is described. The effect of after treatment temperature is estimated by exposing the *Aedes aegypti* L. larvae to a suspension of DDT at one temperature and then after washing in clean water, keeping in a clean container and exposing at different temperatures The results showed negative temperature coefficient of DDT.

28. Studies on the aerial respiration of the Mirror Carp.

A. S DWIVEDI, Nainital.

The Mirror Carp normally keeps alive for 3 to 4 hours out of water. Under special conditions a specimen showed signs of life out of water even after 16 hours. When the aquatic respiration fails in this fish, the bucco-pharyngeal epithelium takes on the function of the aerial respiration. The accessory respiratory function may be assigned to the knob like papillae on the bucco-pharyngeal epithelium of the Mirror Carp. In the absence of both the aquatic and the bucco-pharyngeal respiration, the pseudo-branch performs the function of aerial respiration and keeps the fish alive out of water for more than 16 hours

29. The stress of variable pH on sponge cells.

B. GANGULY, Calcutta.

Exposure of sponge cells to extreme pH variations over pH 9 and below pH 4 will denature protoplasm almost immediately. The effects of pH manoeuvers in lower concentrations, however, show certain remarkable protoplasmic activities in the cell. These are to be considered as responses to an adverse conditon. The influence of alkaline pH stimulates the surface activity and the vacuolar formation. Under the influence of lower pH the pseudopodia formation is receeded and the protoplasm appears condensed. Experiments are done to expose cells alternately to the varying effects of acid and alkaline pH. In another series, the cells are first exposed to alkali followed by acid pH.

The acid effects and alkali effects in the cells are measured mainly by (i) Varying the strength of the pH solution and (ii) Changing the time of exposure. The results show that the sponge cells may become normal from alkaline effects by acid treatments and *vice versa*. But occasionally such counter treatments produce the protoplasmic effects of one sort into another without showing evidence of attaining normalcy. There have been different grades of recovery which have been discussed in the light of probable mechanism of protoplasmic regulation.

30. Effect of cortisone acetate on the alkaline phosphatase concentration in the testes of adult pigeons.

S. GHOSH and A GHOSH, Calcutta.

Appreciable amount of cytochemically demonstrable alkaline phosphatase is present in the germinal components of the seminiferous tubules and in the Leydig cells of the adult pigeon's testis. Cortisone treatment causes an overall loss of this enzyme from the spermatogenic and interstitial cells of the male gonad. Histologically, however, with the exception of Leydig cells hormone-treated testis shows no sign of atrophic changes. The probable significance of the enzymatic inhibition in the testes of cortisone-treated pigeons is discussed.

31. Observations on the cluster-temperature of the Indian Honeybee.

R. P. KAPIL, Allahabad.

This work has been conducted to understand as to how far the atmospheric temperature affects the cluster-temperature of the colonies, which is known to be the backbone of colony development.

During winter months the average cluster-temperature on the central brood combs ranged from 34·7°C to 35 2°C in hive (a) and 35·05°C to 35 4°C in hive (b) The cluster-temperature during summer on the central brood combs also remained the same throughout the period of eight days of observation. The average temperature was 35·3°C to 36 02°C in hive (a) and 35 12°C to 36·02°C in hive (b). The highest temperature recorded on the side combs was 37°C. Direct effect of outside temperature has only been observed on the cluster-temperature of the side combs. The atmospheric temperature appears to have practically no direct effect on the brood-rearing.

32. Effects of pressure pulses on the behaviour of some Plankton animals.

E. W. KNIGHT-JONES & S. Z. QASIM, Swansea & Aligarh.

Animals which had been found to react to changes in pressure were submitted to pulses of positive or negative pressure. In a positive pulse the hydrostatic pressure was increased by half an atmosphere and then allowed to return within one second to atmospheric pressure. A negative pulse involved a similar brief decrease in pressure.

Different species show two different kinds of response to such pulses. The ctenophore *Pleurobrachia pileus*, for instance, treats a positive pulse as an increase in pressure, responding by swimming upwards. To a negative pulse, as to a decrease in pressure, it responds by swimming downwards. Apparently it is the first half of the pulse that calls forth the response, through a message which is not cancelled by the second half of the pulse.

The other type of response can be seen in cyprid larvae of the barnacle, ***Balanus balanoides***. These respond to a positive pulse, as to a decrease in pressure, by embarking on a long period of inactivity, during which they sink passively. It seems that they react to whatever pressure change has happened to them most recently, i.e., to the second half of a pulse.

The method of pressure perception is still entirely obscure.

33. Effects of electrolytes on the mode of entrance of carbon particle across the cell boundary.

S. MOOKERJEE, B. GANGULY and M. CHOUDHURY, Calcutta.

Further experiments have been conducted to explore the phenomenon involved in the mechanism of entrance of carbon particle into sponge cells. Certain electrolytic variations are initiated in the culture condition to observe the entry of particles into a cell.

First, culture medium is made alkaline (ph-9·6). The high pH has two effects. Under alkaline condition, particles of larger size enter the cell. *Secondly*, under acid condition (pH-4), the surface is rendered impassable. *Thirdly*, the effect of heat on the alkali treated cells makes the surface more permeable to large particles. The effect of heat on acidified cell cannot make the surface anyway penetrable to carbon particle. *Fourthly*, the effect of cold makes the alkaline effect in cell ineffective and makes the surface less permeable Cold treatment of alkali treated cells shows entrance of particles of normal size.

Above experiments indicate that the surface phenomenon involved in the entrance of carbon particle is more than a mechanical process. In response to the changed electrolytic conditions, the passability and impassability of carbon particle depends upon the dynamic orientation of the surface structures.

34. Fate of fructose in the body of cockroach.

M. K. K. PILLAI and K. N. SAXENA, Delhi

Most of the available information on the absorption of carbohydrates in insects is indirectly derived from the study of storage of nutrients in the epithelial cells of the gut. Absorption of fructose in the gut of cockroach is described in the paper. The insects are fed a known quantity of fructose. At different time intervals after ingestion the extracts of different parts of the gut and the blood are chemically examined by paper partitian chromatography. A greater proportion of the ingested is gradually transformed into glucose within the gut. The glucose, resulting from this conversion, appears in small quantities in the crop and gizzard. Its quantity gradually increases in the lumen of the midgut and caeca and finally it is absorbed in these two regions. This mode of fructose absorption, via conversion to glucose, is similar to that reported for mammals. However, it differs in that glucose derived from fructose appears on the lumen side of the gut wall while in mammals it appears mostly on the serosal side.

A little part of fructose also passes unchanged into the blood.

35. The Effect of Temperature and Humidity on the Development of Cotton Pink Bollworm, *Platyedra gossypiella*, Saunders.

S. PRADHAN and R. VISWANATHAN, New Delhi.

This paper embodies observations on the development of *Platyedra gossypiella* Saunders, under different combinations of temperature and humidity maintained in the laboratory.

Preliminary observations indicated that at least a certain percentage of the larvae of this pest enter into a state of physiological diapause in the envirous of Delhi. The moths require dim light for mating and oviposition. The larvae could be successfully reared on sprouted beans without any sterlization.

The lower limit for development was found to be near 10°C for eggs and pupae and between 10 and 15°C for larvae. The upper limits for successful completion of development were about 40°C for eggs and pupae and about 35°C for larvae.

36. Experimental studies on the survival of marine teleost larvae.

S Z QASIM, Aligarh.

Rearing experiments on the larvae of two shore fishes *Blennius pholis* L. and *Centronotus gunnellus* (L.) in the laboratory showed that the flagellate cultures namely *Chlamydomonas* sp. and *Isochrysis galbana* Park provide little food value to the young fish. They prolong life only for a few days.

Continuous illumination shortens the span of life of the larvae whereas alternate periods of light and darkness improve the survival considerably. In the course of rearing, moderate agitation of water has a beneficial effect on growth and survival.

Larvae of *C. gunnellus* (an arctic-boreal species) are highly intolerent of high temperatures and require low temperatures for their growth and survival whilst the larva of *B. pholis* (a mediterranean-boreal species) can withstand higher temperatures but soon die at low temperatures. Larvae of *B. pholis* which have swimbladders were seen to suffer from gas disease. No sign of gas disease was noticed in *C. gennellus*, a species which lacks a swimbladder.

37. Effect of conduction heat on the body temperature of *Periplaneta americana* Linn. (Blattaria : Insecta).

R RAKSHPAL, Lucknow.

The body temperature of *P. americana* remains exactly the same as that of its surroundings, i.e. between 18 7 and 37 7°C. Conduction heat can raise its body temperature, and its body appears to be a good conductor of conduction heat. At lower temperatures the body absorbs more heat by conduction than at higher temperatures during the same period. The disparity in temperature between the heat-giving body and the heat-absorbing body is directly proportional to the heat absorption by the body of cockroach.

38. Action of Mammalian hormones on Spawning Catfish and frog.

L. S. RAMASWAMI and A. B. LAKSHMAN, Bangalore.

Gravid Catfish and frogs can be spawned with parenteral injections of their respective homoplastic pituitary gonadotrophins. Large doses of chorionic gonadotrophin also spawns the catfish but not frogs. As the hormones appear to work selectively, we have tried all the mammalian hormones (follicle-stimulating hormone, pregnant mare serum, luteinizing hormone, estradioldipropionate, methyltestoterone, progesterone, cortisone, adrenocorticotrophic hormone, growth hormone, thyrotrophic hormone, oxytocin, thyroxine and insulin) individually and also in combination with a threshold dose of respective pituitary gland. It was found that progesterone and androgen ripened the eggs of frog but not those of catfish but the latter gave ripe eggs when receiving combination dose. Frogs give ripe eggs after receiving combination doses of all the above named hormones except oxytocin. The catfish did not react even with combination doses of Pregnant mare serum, Adrenocorticotrophic hormone and Oxytocin. Estradioldipropionate gave very poor reaction.

With regard to the failure of ACTH and Estrogen, it is argued that since the fish interrenal does not elaborate desoxycorticosteroid hormone, it is likely that the chain reaction estrogen-adrenocorticotrophic hormone-desoxycorticosterone does not help the pituitary luteinizing hormone in ripening the eggs.

39. Total amino-acids in the bloods of some crustaceans, molluscs and vertebrates.

P. V. RANGNEKER, Amraoti.

A quantitative analysis of the amino-acids obtained from the blood of crustaceans, molluscs and vertebrates is given. The colourless blood of *Lamellidens* differs from that of other molluscs, crustaceans and vertebrates in its amino-acid composition. The yields of the different amino-acids obtained from the colourless blood are very low and moreover, phenylalanine and tyrosine are completely absent. With a few exception, the amino-acid concentrations of the red and blue bloods offer a favourable comparison.

40. Digestive enzymes of *Oxycarenus hyalinipennis* (Costa) in relation to its tissue preferences on cotton plant.

K. N. SAXENA and PREMLATA BHATNAGAR, Delhi.

Present study was undertaken to ascertain correlation between relative presence of *Oxycarenus hyalinipennis* (Costal) for different parts of cotton plant and its ability to digest and utilise the nutrients available in these parts.

The insect shows maximum preference to cotton leaf as the source of food and least to cottonseed. While feeding on the leaf, the insect draws food sap mostly from mesophyll and phloem tissues, rarely from xylem vessels and never from the oil-glands scattered all over the leaf and other parts. The insects feeding on cottonseed draw food material from the seedcoat (hull). They do not introduce their stylets deeper than the seedcoat and, consequently, never feed on the kernel or embryo of the seed.

Nutrients available to the insects feeding on cotton leaf are proteins, some free amino acids, starch, sugars (sucrose, glucose and fructose), and fats. Those available in the cottonseed-coat are pentosans, sugars (raffinose, sucrose, glucose and fructose), free amino acids and very little of proteins and fats. Study of digestive enzymes of the insect indicates that cellulase, hemicellulases, inulase, β-glucosidases, β-galactosidases, polypeptidases and lipase are absent. Amylase, maltase, invertase, α-galactosidase, proteinase and esterase occur in the salivary secretion and in the midgut. Their occurrence in the hind-gut is quite irregular. Trehalase has been detected only in the midgut. Maximum activity of almost all these enzymes occurs at pH 5·4. The invertase present in the insect is a glucosaccaharase.

Correlation between the nutrients available in cotton leaf or in seedcoat and ability of the insect to utilise the nutrients has been discussed. Cotton leaf appears to be much better a source of food for *Oxycarenus* than cottonseed.

41. Oxygen Consumption by Freshwater Fish.

A. SREENIVASAN, Bhavanisagar.

Oxygen consumption by some economic and uneconomic freshwater fishes have been determined. The "asphyxial" level of Oxygen concentration has also been recorded, the lowest being that for mirror carp at 0·35 to 0·40 mg/L (4·204 to 4·257% saturation). When Oxygen consumption is calculated as mg. per gram of body weight per hour, it was found that fry consumed per unit weight more Oxygen than fingerlings and the latter, more than adults. Larger fish consumed less Oxygen per unit weight than did smaller fish. Likewise "group effect" was also noticed. Fish when present in groups consumed less Oxygen per unit weight than did lone fish or pairs, the volume of medium being the same. Volume of water itself affects Oxygen consumption by fish of same size and species, greater amount of Oxygen being consumed when volume of water is greater. Salinity appeared to have some effect on oxygen consumption by *Chanos*. At 50% seawater there was a marked reduction in Oxygen consumption as compared with 100% seawater. Tranquillizers and hypnotics such as thiouracil, Urethane, (thyroid depressants) and Veronal etc reduced Oxygen consumption by fishes. The possibility of drugging live fish during transport to reduce mortality, thus appears promising.

42. Aureomycin as Growth promoter of cultivated Fish.

A. SREENIVASAN, Bhavanisagar.

In pond culture, artificial feeding will increase the growth of fish. As a supplement "aureocycin" is found to have a very remarkable growth promoting effect. This was used as "Aurofac", a formulation containing 1·8 mg/lb aureomycin and 1·8 mg/lb vitamin B_{12}. *Gourami* and *Tilapia* were used as test fish. Young Gourami was found to have a growth increment of 500% in one month In slightly bigger fish the increment in growth was less (120% for *Tilapia* and 100% for *Gourami*), but this was considerably better than with ground-nut cake alone. The "food conversion ratio" is lowered when aureomycin is added to the food.

43. Growth Potential of *Laphygma exigua* in relation to certain winter food plants.

B. K. SRIVASTAVA, Udaipur.

The leaf eating caterpillars, *Laphygma exigua* Hb. are very general feeders and have been observed to attack almost all the cultivated crops. During the 1957-58 rabi season large populations were noticed on many crops. In some crops their population was very high resulting in severe damage while in others in the same vicinity they were hardly of any economic importance. Some of these resistant crops have been listed as important hosts of this insect by many workers. It is now well-known fact that one of the most important factors which determines the distribution of insects on different crops is the capacity of food to support growth.

Hence, a study was undertaken to investigate the relation between the food plant and the growth of this insect.

The larvae were reared on seven natural winter food plants and the growth response of the insect recorded using the standard technique. This response was judged by the growth index which was calculated by dividing the percentage of larvae becoming adults with the average time taken to complete the development.

Potato (*Solanum tuberosum*), pea (*Pisum sativum*), lucerne (*Medicago sativa*) and berseem (*Trifolium alexandrinum*) were found to be most nutritious than others. Linseed (*Linum usitatissimum*) and tomato (*Lycopersicum esculenium*) were poorer while brinjal (*Solanum melongena*) was the worst food of all the plants tested. The pupal period was not affected by the difference in food but the size of the adults produced was variable. The adult size was evidently correlated with the nutritive value of the food. From nutritious plants larger size of adults were obtained while in plants of lesser nutritive value small sized adults were produced.

44. The respiratory currents in the tracheal system of two species of Coleoptera.

G. T. TONAJI, Poona.

The present investigation involves the study of air currents and factors governing their direction in the two species of Coleoptera viz. *Holotricha serrata* Fabr. and *Evides elegans* Fabr. The number, position and functional morphology of the spiracles are described. An exhaustive account of the system of tracheae and air-sacs is given. The rate and amplitude of breathing movements are recorded. Available results indicate that normally the thoracic spiracles are chiefly inspiratory whereas the abdominal spiracles are mainly, but not exclusively, expiratory and the last pair is very much so. This course of air current i.e. inward through the anterior spiracles and outward through the posterior spiracles, is subject to some variations depending on the carbon dioxide concentration. The abdominal spiracles are capable of inspiration and the reversal of air current is limited in the abdominal region. Effects of such factors as carbon dioxide, temperature, food and starvation are noted.

45. Observations and experiments on the behaviour of the egg-laying female of *Papilio demoleus* Linn.

VIDYADHAR G. VAIDYA, Poona.

Females of *Papilio demoleus* were kept in a large cage devoid of any coloured object apart from those specially provided for the experiments. To these were offered artificial leaves prepared from the different papers of the Ostwald colour series and Bauman grey series.

On these the insects showed, only in the presence of the odour of the host plant, a characteristic 'drumming response'—tapping with fore-legs on the surface of the leaf—which precedes actual egg-laying under natural conditions. The number of such responses on different papers were counted separately. The results clearly show that the females of this insect react during oviposition to a restricted range of blue-green and green colours. Further, it was observed that a certain attractive saturated colour does not lose its effect if offered in other degrees of brightness and saturation; its attractiveness, in fact, gains by a little admixture of 'white' though its degree of saturation—at least for the human eyes—has been diminished.

IV. PROTOZOOLOGY

46. Conjugation in a new species of *Blepharisma* (Protozoa : Ciliata).

(MISS) A. VASANTHI BHANDARY, Bangalore.

The nuclear apparatus of *Blepharisma* was found to be different from that studied so far. A moniliform macronucleus with beads of equal size and multiple micronuclei was characteristic of the species. In conjugation eight micronuclei take part in the first pregamic division, six in second division, and one in third division. The synkaryon divides twice giving rise to four bodies, three of which become macronuclear anlagen and one the micro-nucleus, which divides four times. Exconjugant at this stage divides into two daughter cells, of which the one containing two macronuclear anlagen divides once again to establish nuclear balance. The macronucleus condenses, elongates and then becomes moniliform. Simultaneously, the micronuclei also undergo division. It is clearly established now that the macronucleus divides amitotically and the micronuclei mitotically.

Conjugation was encountered fairly frequently and starvation was one of the factors that induced it.

47. Species Sensitivity of Soil Amoebae to Trinitrophenol.

B. HAJRA, Calcutta.

The cysts and the trophic forms of two species of soil Amoebae *Negleria gruberi* and *Acanthamoeba* sp. were exposed to different concentrations of picric acid solutions to test their differential reactivities. The various concentrations of picric acid solutions used were ·01%, ·05%, ·1%, 1%, 10%, 20%, 30%, 50% and saturated solution or 100%. The LD 50 of the cysts of both species was about the same, which results while using 20% solution. No survival was recorded in any higher percentage. The resisting capacity of the trophine forms, however, seems to be different. The sublethal dose for the trophic forms of *Negleria gruberi* was ·1%. However, the sublethal dose for *Acanthamoeba* sp. was still lower than ·05%.

When the trophic forms are treated with sublethal doses of picric acid solution, the first observable reaction is seen in the excitement of the cytoplasm by vigorous movement followed by a process of gradual loss of granulation. An enlargement of the nucleus is also observed.

The above changes are not permanent, as after lapse of some time, the physiological processes take place in the reversed manner and the amoebae either show normal trophic nature or they enter into cystic forms. The time taken for the different cytoplasmic reactions and the subsequent regulation, even in the same species with same dose, is variable.

48. Serological Studies on *Blepharisma* (Protozoa : Ciliata).

B. R. SESHACHAR, (Miss) A. VASANTHY BHANDARY and
A. V. S. PRABHAKARA RAO, Bangalore.

Serological studies on *Paramecium aurelia* by Sonneborn, Beale, Harrison and others have demonstrated the occurrence of specific antigens on the surface of this animal. The antigen-antibody relationship is highly characteristic in this organism and has led to the formulation of certain general theories regarding this relationship. An extension of these observations was made to another ciliate, *Blepharisma*. Many species of this genus possess a characteristic pigment located in the surface pellicle and studies have been directed to determine the nature of this pigment and the conditions of its production and formation. It was also felt desirable to study the behaviour of this pigment in the context of any antigen-antibody relationship that obtained in the animal.

The methods adopted were largely those employed by Sonneborn and Beale for *Paramecium*. The effects of the antibodies however, were very different. In certain concentrations (1 :10) the most characteristic effect was a complete loss of pigment from the pellicle which comes off the animal in a cloud. Later, the protoplasm is ejected, leaving an empty shell of the pellicle. It is highly significant that even after the protoplasm is ejected, the cilia continue to be active on the now denuded pellicle. No clumping of cilia is observed. In other concentrations (1 :100) however, the movement of cilia becomes restricted and ultimately paralysed. But a matting and agglutination of cilia described for *Paramecium* have not been noticed.

V. HELMINTHOLOGY

49. Our present knowledge of plant-parasitic and soil nematodes from the Indian region and importance of their study.

B. S. CHAUHAN and G RAMAKRISHNA, Calcutta.

The paper deals, in a general way, with the damage caused to different kinds of plants and food crops by soil and plant nematodes. The subject has been dealt with in detail and the importance of their study has been discussed. It has also been pointed out how studies on the subject have been neglected in India so far and need for paying greater attention to the subject has been stressed. All cases of the occurrence of worms of this group recorded from India so far have been mentioned, together with localities from which the cases have been reported and the names of the host plants. A bibliography is given at the end. Pathological symptoms shown by the affected host plants are indicated. Detailed taxonomic classification of the worms recorded so far from the Indian region is given and each case discussed briefly.

50. On a new interpretation of the structures seen in the integument of *Fasciola indica*.

M. B. LAL, Lucknow.

The present investigation on the integument of *Fasciola indica* employing various multi-stains, some chemical reagents and technique have revealed the presence of three layers in the cuticle, viz. a superficial very thin membrane which gets separated in sections treated with hot dilute alkali, a comparatively thicker layer of 40 micron having vertical striations and lastly the innermost layer of 10 microns which stains deep blue with Mallory's triple stain. This is different from reported single-layered cuticle in the European liver fluke, *Fasciola hepatica* (*Distomum hepaticum*). The gland-like cells reported in *F. hepatica* by Hein (1904) and also seen in *F. indica* are now designated as mesenchyme cells.

51. Some histochemical observations on the cuticle of *Fasciola indica*.

M. B. LAL and S. C. SRIVASTAVA, Lucknow.

The present work on the cuticle of *F. indica* is based on a series of histochemical observations. These investigations especially with regard to proteins, glycols, phenols, di-sulpher bonds and fats have revealed that a glycoprotein forms the main constituents of the cuticle of *F. indica.* The absence of the other normal components of cuticle as found in other helminths is reported.

52. *Reptiliotrema primata* n.sp. (Echinostomatidae) from the intestine of Rhesus monkeys.

PREMVATI, Lucknow.

A new species of *Reptiliotrema primata* is described from the small intestines of Rhesus monkeys. It is distinguished from the only other representative of the genus *Reptiliotrema* viz. *R. indicum* by the number and arrangement in a single row of collar spines, relative position of the ovary and receptaculum seminalis, relatively larger size of the ovary, broader anterior testis, greater posterior extension of the cirrus sac, and lastly by having a mammalian host. The genus *Reptiliotrema* is recorded here for the first time from mammals.

53. Culture methods for the free living stages of Parasitic Nematodes.

PREMVATI, Lucknow.

Experiments for hatching the eggs of *Oesophagostomum, Trichostrongylus, Chabertia, Nematodirus, Haemonchus* and *Strongyloides* were performed with a number of sterilised natural soil cultures of different pH. All other factors like temperature, consistency, moisture, number of eggs were kept constant. It was noticed that sterilised cowdung with a higher pH proved to be most satisfactory, where cent per cent hatching took place.

54. Studies on the genital organs and the patterns of variations found in *Hymenolepis diminuta* (Rudolphi) from rats of Delhi State.

DHARAM PARKASH SINGAL, Delhi.

Hymenolepis diminuta (Rudolphi, 1819) is a common cestode parasite reported from rats (*Rattus rattus* Gray, 1837) in Delhi State. The investigations on the present material of *H. diminuta* indicate several interesting variations in the position of the testes in relation to the female genital organs and the genital opening. In addition, irregularities in the number of testes and the consequent variations in their disposition have also been brought to light.

55. On a new species of the cestode belonging to the genus *Hymenolepis* Weinland, from common Indian Mynah from Delhi State.

DHARAM PARKASH SINGAL, Delhi.

Hymenolepis vitellolobata n. sp. is reported from the small intestine of common Indian Mynah *Acridotheres tristis tristis* (Linnaeus, 1766) from Delhi State. The worms measure 56-63 mm. in length and 1·095—1·450 mm. in breadth. Scolex measures 0·565 x 0·260 mm. Rostellum is well developed and carries a single crown of 24 rostellar hooks each measuring 0·019—0·020 mm. in length. Rostellar sac extends well below the lower margin of the suckers. Suckers measure 0·110—0·120 mm. in diameter. Genital pore is unilateral. Genital cloaca is well developed. Cirrus sac is well past ventral longitudinal excretory vessel and extends to nearly one-fifth width across the proglottid. It measures 0·217—0·265 x 0·046—

0·062 mm. Cirrus is unarmed and opens into the genital cloaca. Testes, three in number, are disposed in a triangular pattern. A prominent receptaculum seminis is present. Ovary is a transversely elongated structure with several smaller lobes protruded out from its anterior and lateral border. Vitelline gland, highly lobed, is characteristic. Uterus is an irregularly lobed sac limited within ventral longitudinal excretory vessels. Eggs and onchospheres measure 0·051—0·060 x 0·038—0·046 mm. and 0·028—0·039 x 0·023 – 0·028 mm. in diameter respectively. Embryonic hooks, six in number, measure 0·013—0·015 mm. in length.

By comparing all the species reported under the genus *Hymenolepis* the present form is distinguishable from all of them, thereby justifying the creation of *Hymenolepis vitellolobata* n. sp. for its reception.

56. The Morphology of the Miracidium of *Euclinostomum heterostomum* (Rudolphi, 1809).

ONKAR NATH SRIVASTAVA, Gyanpur.

A detailed account of the morphology of the trematode *Euclinostomum heterostomum* (Rudolphi, 1809) has been given here for the first time. In the absence of any other account of the miracidium of the genus *Euclinostomum* the present account has been compared with that of the miracidium of *Clinostomum complanatum* given by Yamaguti (1933) and that of *Clinostomum marginatum* given by Hunter and Hunter (1935). The miracidimum of E. *heterostomum* closely resembles the miracidium of C. *marginatum* in shape,—in the presence of 21 epidermal plates arranged in four tiers, in the position of the pigmented eye spots, presence of the lateral papillae and the refractile excretory vacuoles. But the miracidium of E. *heterostomum* differs remarkably from that of *C. marginatum* in the presence of the lateral processes, in the four pairs of penetration glands, in the eyespots being submedian in position and in being composed of pieces lying contiguously, in the larger size of the brain and the distribution of the refractile vacuoles.

VI. ENTOMOLOGY

57. Some Interesting Features of the Life-history and Larval Anatomy of an Encyrtid-parasite of Coccid.

S. MASHOOD ALAM, Aligarh.

Doliphoceras pseudococci Alam is an endo-parasite of *Pseudococcus newsteadi* Green which is a host of *Fagus sylvatica* L. The parasite has only one generation in a year. This coincides so perfectly with vulnerable stage of hosts' life-cycle that the parasite can be taken as a successful one. Neither any competitor nor hyperparasite is so far recorded. All the developmental stages are present, and parasite's activity gets accelerated after winter sleep to cause ultimate death of host. External bulgings on hosts' body as a result of development of parasite are a good distinctive feature of parasitized host.

The larval anatomy incorporates both external and internal structures. Larva is enclosed in a membranous envelope—an observation contradictory to present writer's (1956) own observation in *Aphytis diaspidis* Howard. The tenth segment bears a pair of processes : The respiratory and nervous systems assign a higher evolutionary status to Encyrtidae over Braconidae.

58. A comparative study of the neurology of the different castes of the termite, *Odontotermes redemanni* (Wasmann).

BARUNDEB BANERJEE and DURGADAS MUKERJI, Calcutta.

Comparative studies on the development, differentiation and histology of the brain of all the cases of termite, *Odontotermes redemanni* (Wasmann) have been undertaken. It has been noted that there is a correlation in the structure, size and the degree of the development of the brain, and the eyes in all the castes.

In the sexual alates and de-alates, the large brain is very peculiar, in having the conspicuous mushroom bodies and well differentiated antennary and optic lobes. Among the worker soldier castes the brain does not fill up the cavity of the head completely, and the mushroom bodies are less differentiated. The antennary and the optic lobes are also smaller. The brain cells of the sexuals give a fair reaction for the enzyme, Alkaline phophatase, but the intensity of the reaction is slightly higher in workers than in the soldiers.

Attempts have been made to determine the neurosecretory cells in the different castes of the termite, *Odontotermes redemanni* (Wasmann).

59. Biology of *Macroceroea grandis* (Gray), (Pyrrhocoridae, Hemiptera).

K. P. BANERJEE and D. N. RAYCHOUDHURI, Calcutta.

The present study reveals that the insects feed on the rotten fruits of *Trewia nudiflora* (Euphorbiaceae) and Gossypium plantation is absolutely free from infection. The insects are usually found under bushes near *T. nudiflora* specially when the land is somewhat moist and the atmosphere is somewhat cool and humid. The species could never be collected in copula though eggs and different instars occurred at a particular place. They were observed as runners. In the laboratory they were noticed as negatively phototropic.

60. *Aphis nerrii* Boyer and leaf growth of *Calotropis gigantea.*

H. K. BHOWMIK and D. N. RAY CHAUDHURI, Calcutta.

The relationship between aphid (*Aphis nerii*) infestation and leaf growth of the host plant, *Calotropis gigantea* has been worked out. The infestation is maximum on the growing leaves, moderate on full grown leaves, and negligible on the senescent ones. The pattern of infestation has been correlated with the feeding habits and reproductive capacity of the aphid.

61. Some aspects on the Physiology of Digestive Organs of *Dysdercus koenigi* (Fabr.).

N. B. CHATTERJEE, D. N. RAY CHAUDHURI and D. D. MUKERJI, Calcutta.

This paper deals with the fate of cellulose (chief constituent of Cotton sap) inside the insect, the detection of amylase and invertase, and the secretory and the absorptive regions of the gut. The pH of the salivary glands, the saliva, the different portions of the gut and the faeces have also been noted.

It reveals that pH of salivary glands varies from 6·0 to 6·7 while that of saliva from 6·2 to 6·4. In this species the pH of the foregut varies from 5·5 to 6·1, while that of the three regions of the midgut varies from 5·8 to 6·5, 6·0 to 7·0 and 5·3 to 6·3 respectively. The hindgut shows weakly acidic reaction and the same is obtained for the faeces.

Amylase is secreted first by the salivary glands and then again by the second region of the midgut. Invertase is totally absent both in the salivary glands and the foregut, while in the first region of the midgut it is present in a negligible quantity. In the second region invertase reaction is highly powerful.

From the splitting of cellulose it is evident that digestion starts from the first region of the midgut and is complete in the third region.

By the injection of Methylene blue it seems that the third region of the midgut is the most secretory region. From this reaction, it is clear that some other enzymes may be given out by this region.

In the present paper some light has been thrown on the dissolution of plant cell wall by the acidic saliva.

62. A study of components of insecticidal resistance, its development and heritability.

A. K. DATTA GUPTA, Pilani.

Development of insecticidal resistance has been studied in populations of *Calandra granaria L.* and *Callosobruchus chinensis L.*, particular stress being laid on the importance of repeated selection within a generation. Resistant part of an initial population when separated from the susceptible part after one treatment with pyrethrum or BHC (sublethal) has been observed, to contain large numbers of susceptible insects. Consequently, two types of resistance, depending on their consistency, have been distinguished. Consistent resistance to repeated treatments with insecticide has been defined as long-term resistance, whilst fluctuating resistance the short-term resistance. The long-term resistance has been observed to increase rapidly in the successive generations of the insect population, if the short-term resistant insects are completely eliminated from each generation by repeated selection within each generation. Insects' long-term susceptibility to insecticide developed in a manner similar to that of long-term resistance. The F_1 progeny of the resistant or the susceptible strain has been observed to be more resistant or more susceptible respectively than their parents, thus showing that at least a part of the resistance or the susceptibility is inherited. Long-term resistance or long-term susceptibility decreased gradually when selection was stopped. Experiments were performed to study the response of the progeny of the pyrethrum or BHC resistant males and the pyrethrum or BHC susceptible females and *vice-versa*. The results of these assays and other observations point to the conclusion that resistance of *Calandra granaria* or *Callosobruchus chinensis* to pyrethrum or to BHC develops by the additive influence of a number of dominant genes and that the character is sex-linked. These genes may be masked or buffered by simple alleles or other associated gens.

63. Response of some grasshoppers (Acrididae) to pyrethrum.

A. K. DATTA GUPTA and V. K. Divakaran, Pilani.

Loss of body weight has been found to be a primary response of some grasshoppers (*Spathosternum prasiniferum* Walk, *Acrotylus humbertianus* Sauss. and *Cyrtacanthacris tatarica* L.) to treatments with small drops of pyrethrum solution. This loss of weight has been suggested as a function of the total quantity of water expelled from the body. Loss of water along with the regurgitated matter and that associated with the respiratory gas are the two main processes through which water is expelled. An examination of the record of the rate of respiration reveals that the spiracles of the treated insects during expiration remain open for periods longer than the normal and consequently excessive quantity of air escapes from the tracheal system.

64. Mode of ingestion in Indian mustard saw-fly *Athalia proxima* Klug (Hymenoptera : Tenthredinidae).

SURJIT S. DHILLON and S. MASHHOOD ALAM, Aligarh.

In *Athalia proxima,* the dorsal diverticulum divides the cephalic stomodaeum into anterior pharynx and posterior pharynx. The former combines with cibarium to form the sucking pump which communicates with the food meatus through a functional mouth.

Labio-maxillary complex's tip licks the liquid food, which then is flexed and approaches in the vicinity of the functional mouth. On contraction of the clypeal dilators the food is sucked into the sucking pump, under pressure. Due to the contraction and relaxation of the different sets of dilators as well as the compressors of the sucking pump, the food gets placed into the dorsal diverticulum. Then it flows on into the dilated posterior pharynx. The latter shrinks due to the relaxation of its dilators so as to push the food into the oesophagus.

65. Occurrence of intersegmental pores on the dorsal tergites of the common cockroach, *Periplanets americana* Linn.

RAMKRISHNA GHOSH and S. N. ROY CHOUDHURY, Calcutta.

Occurrence of innumerable pores on the abdominal dorsum of cockroach is reported for the first time. These are present in a definite pattern on the intersegmental membranes connecting the first four abdominal tergites; in the first one these are arranged along the entire anterior border but these are more profuse on the antero-lateral corners, while in the subsequent ones only on the antero-lateral corners. These are connected by minute branching tubules with the perivisceral cavity below. Not only the stigmal pores but also these apertures may help in diffusion of gases directly between environment and perivisceral body fluid.

66. Studies on the spiracles and tracheal system of the common cockroach, *Periplanets americana* Linn.

RAMKRISHNA GHOSH, S. N. ROY CHOUDHURY and D. D. MUKERJI, Calcutta.

This paper deals with the morphological and histological studies of the spiracles and with the tracheal system in the different parts of the body of the cockroach.

Histologically the thoracic spiracles differ very much from the abdominal ones in the shape of the atrial canal, setae and in their opening into the spiracular trachea.

On the first day of emergence the second thoracic spiracle is closed though the spiracular area is quite differentiated and the rest are open. It is suggested that the posterior chamber is first formed and then the anterior chamber. At this stage, the atrium of the abdominal spiracle is not differentiated into anterior and posterior chambers. There is a sort of ball and socket arrangement for opening and closure. Three sets of muscle strands are attached to it.

It is observed that the cockroach possesses three principal tracheal sets, i.e., dorsal, middle and ventral, arising from the spiracular tracheae.

The heart, alary muscles and fat-bodies etc. are supplied by the dorsal set which originates from the dorsal side of spiracular tracheae and is spread over the dorsal viscera. Most of the visera e.g., the alimentary canal, the salivary glands and their ducts and the male and female reproductive organs are supplied by the middle set arising from the inner side of the spiracular tracheae. The salivary receptacle and vas deferens are without any tracheal supply. The ventral set originates ventrally from the spiracular tracheae and supplies the nerve cord, legs and the accessory reproductive glands.

Different parts of the head and the cephalic appendages are supplied by two main branches coming from the first thoracic spiracles

67. Anatomy and histology of the alimentary canal of honeybee *Apis indica* Fab. (Apidae, Hymenoptera).

R. P. KAPIL, Allahabad.

The paper incorporates the study of the alimentary canal of a worker and a drone of *Apis indica*, and many points of interest--such as the structure of the proventriculus, superficial border of the epithelium of the midnight and the nature of the secretory vesicles—have been discussed.

The ratio between the length of the alimentary canal and body bears proportionate relation in an individual of each caste. The pharynx is distinguished into two parts pharynx anterior and the pharynx posterior. The proventriculus has been histologically divided into two parts—proventriculus anterior and the proventriculus posterior. The lips of the former are arrow-headed, fringed with two sets of hairs, whose arrangement on them has been fully described. In the latter not only the hairs and the longitudinal muscles in the core of the lips are absent, but also the pouches gradually obliterate. The free cell surface of the epithelial cells of the midgut lacks striations. Two types of midgut cells are polyphasic in nature, each phase representing an aspect in the mode of secretion. This, however, suggests that the secretion in the midgut is discharged through three probable ways, occurring in succession, and largely depending on the activity of the cells. The secretory vesicles, formed as a result of disintegration of the digestive cells, have been believed to function as 'the secretion carrying capsules'. The malpighian tubules are about twenty-nine in number and each measure about 5 mm. in length. The globular bodies, usually given off from the epithelium, appear to be analogous structures to those of the midgut.

68. On a Urentius species (Tingididae : Heteroptera), from Pilani (Rajasthan).

R KUMAR, Pilani.

A species of the genus *Urentius*, breeding on an endemic plant *Abutilon indicum* and similar to *Urentius sentis* of Bombay and Surat is described. It has the following features hitherto unnoticed.

1. There is a strong vacuolated rod-like structure of fair size originating close to the base of each of the fore wings (elytra) on the site next to the scutellum (when the wings are closed). Possibly it represents *clavus* which may have become almost separate and is lending some mechanical support to the wing.
2. On the hind wing the subcosta and radius enclose an oblong area between them. Costa, sub-costa and radius are fused together at their bases.
3. The middle of the three frontal spines of the head is bifurcated at its tip.
4. The fourth joint of each antenna is club shaped, yellowish and densely hairy.

69. Responses of immature Coleoptera to fumigation. Part—I. Effects of methyl bromide on mealworms (*Tenebrio molitor* : Tenebrionidae).

H. L. KUNDU, Pilani.

Effects of fumigation on the eggs and the various larval stages of *Tenebrio molitor* under different conditions have been studied. Fumigations were carried out in a close steel chamber at 15°C. while the dosage and the toxicity of the fumigant were expressed in terms of concentration time product (as mg./hr./lit.) and dose necessary for 50% mortality (as LD_{50}).

The LD_{50} for eggs, newly hatched larvae, larvae of 3/4th instar, ultimate instar and pupae were of the order of 40, 18, 63, 83 & 71 mg./hr./lit. respectively. Larvae which were treated repeatedly with sub-lethal doses punctuated with recovery periods, could withstand a much higher dose than their normal LD_{50} Moreover, when mature larvae were fumigated their pupation was delayed. Fumigated mealworms lost more in weight than the unfumigated larvae.

The high susceptibility of the newly hatched larvae in comparison with the eggs, might be due either, to the high respiratory activity or, low resistance of the larvae. Toleration of the cumulative effect of the repeated sub-lethal doses, is perhaps owing to the metabolisation or detoxification of the toxicant when administered in sub-lethal doses. Methyl bromide affects adversely the water-balance of the larvae which was evidenced through increased loss of weight

70. Responses of immature Coleoptera to Fumigation. Part—II. Effect of methyl bromide on wireworms (*Agriotes* sp. : Elateridate).

H. L. KUNDU, Pilani.

Wireworms of the species *Agriotes obscurus* and *A. sputator* were fumigated under different conditions. The LD_{50}s of the larvae fumigated within soil and when fumigated outside soil were 47 & 45 mg./hr./lit. respectively. Those larvae which received a lethal dose showed an enormous increase in weight (of the order of 35—55% of the original body weight), and became turgid within 3-4 days of fumigation. Most of these turgid larvae died within 10-20 days after fumigation. Those which did not die, underwent moulting and regained their normal weight

Symptoms have been discovered with which larvae which show a pre-death turgidity (owing to fumigation), can be distinguished from the larvae which show pre-moult turgidity.

71. Studies on the insect population of Pilani (Rajasthan). Part—II. A survey of the coleopterans with the light-trap.

H. L. KUNDU and A. K. DUTTA GUPTA, Pilani.

In the course of this survey more than 300 species of insects belonging to different orders have been collected. Ninetyone of these insects are coleopterans of which 38 have been identified up to species.

These 38 identified beetles consist of 5 Cicindelids, 5 Elaterids, 2 Bostrychids, 1 Paussid, 9 Scarabaeids, 7 Carabids, 1 Dytiscid, 2 Coccinellids, 4 Meloids and 2 Curculionids.

There are two species of Paussids which were hitherto unknown here. One of these is *Paussue madurensis*.

72. Common coleopteran fauna of soil in four different localities showing variable physical conditions of soil at Allahabad together with brief notes on their habitat.

K. S. KUSHWAHA, Udaipur.

Soil Coleopteran fauna was studied at Allahabad in 1949, from August to November, in four areas showing variable physical conditions of soil, *i.e.*, vegetation, manuring and tillage of soil :

Altogether 68 species belonging to 50 genera and 9 families were recorded. 25 species belonging to 18 genera and 7 families were recorded on Botanical Farm, 22 species belonging to 18 genera and 6 families in Mylaha, 18 species belonging to 13 genera and 4 families in Botanical Garden, and 13 species belonging to 13 genera and 6 families on Parade Grounds

Cicindelids and Scarabs predominated at the Botanical Farm while Carabids and Tenebrionids in the Mylaha, and Carabids in the Botanical Garden and at the Parade Grounds.

Families Carabidae, Scarabaeidae and Tenebrionidae were represented in all the areas. Cicindelids and Cantharids were recorded only from Botanical Farm while Histerids only from Mylaha. Further, Elaterids were absent from Botanical Farm and Curculionids from Botanical Garden whereas Staphylinids were absent both from Mylaha and Botanical Garden.

73. Studies on the external genitalia of the Indian divine beetle *Cybister tripunctatus asiatics,* Sharp.

S. N. MATHUR and NAR SINGH SIDHU, Pilani

A detailed study has been made of the functional anatomy of the external genitalia of both male and female *Cybister tripunctatus asiaticus.*

The External male genitalia consists of a trilobe type aedeagus, consisting of a median lobe, two lateral lobes or parameres and a median strut, which controls the movement of the parameres. The male genital armature is placed with its right side downwards when in rest.

The External Female Genitalia consists of a sickle shaped ovipositor with 8th and 9th sternal plates modified as genital armature. In the process of egg laying the 7th sternum is depressed down, the ovipositor projects out, the 8th sternum stands perpendicularly, the 9th sternum passes out and the sickle shaped gonopophyses of ovipositor bore into the plant tissue and the eggs are deposited.

The mechanism of copulation and oviposition and the functional importance of each part of genitalia in these processes have been described in detail.

74. Studies on the morphology and anatomy of reproductive organs of *Cybister tripunctatus asiaticus,* Sharp.

S. N. MATHUR and NAR SINGH SIDHU, Pilani.

The sexual dimorphism in *Cybister tripunctatus asiaticus* is well marked. In male the first three tarsi of 1st pair of legs are modified into fan like structures provided with large number of adhesive papillae which effect attachment of fore legs on the body of female at the time of copulation.

The male reproductive organs consist of paired testes, paired vasa deferentia, one pair of accessory glands, and a common ejaculatory duct formed by the fusion of two lateral genital ducts. Testes are simple long coiled tubes. Each vas deferens forms a coiled epidydimis. Sperms show spindle shaped biflagellate nature.

The female reproductive organs consist of paired polytrophic type of ovaries, each with fifty two ovarioles, paired oviduct, a median common oviduct, paired small bud-like accessory glands, thick muscular vagina lying with its right side downwards, and a spermatheca to store sperms at the time of copulation. The accessory glands of the female are very small and placed on lateral sides of the anterior most end of the vagina Spermatheca and common oviduct open into the anterior most end of the vagina.

75. New species of the Genus *Anagyrus* Howard (Chalcidoidea : Encyrtidae) recorded from Aligarh.

MAN MOHAN and S MASHHOOD ALAM, Aligarh

Genus Anagyrus Howard is reported for the first time and is new to the sub-continent, three species are also reported as new.

Anagyrus mirzai sp.n., closely resembles *Gyranusa* Mercet for having similar wing venation, but is easily distinguished by its broad lamina, broad costal cell, posterior margin of the pronotum straight and frontovertex narrower than eye These are reared from *Pseudococcus citri* Risso.

Anagyrus punctulatus and *Anagyrus aligarhensis* spp.n come close to *Anagyrus swezeyi* Timb. and *Anagyrus saccharicola* Timb. But their antennal coloration and the condition of the frontovertex coupled with the close proximity of the antennal sockets from the oral margin make them stand out as new species.

Anagyrus punctulatus sp.n. not only differs from *Anagyrus aligarhensis* sp n in the already established specific characters. Their size, thoracic condition, wing venation and the form of the various components of female external genitalia also support the separation of these species. It is further confirmed by studying the males of these species These are reared from *Pseudococcus* species on sugar cane

76. A new subfamily of tingidae (Heteroptera : Tingoidea) from India.

M. G. RAMDAS MENON and S. AFSARUL HAKK, New Delhi.

The family Tingidae (Hemiptera : Heteroptera) is known from India by five subfamilies, viz, Cantacaderinae Stal, Serenthinae Stal, Tinginae Stal, Aidoneusinae Distant and Axiokersinae Distant The authors have found a peculiar tingid species from Coimbatore, South India, whose characters do not agree with those of any of the five subfamilies mentioned above. A sixth subfamily, by name, Phyllogasterotinginae has, therefore, been erected to include that species in the taxonomic account of the family Tingidae. This subfamily, along with the genus *Phyllogasterotingis* and the species *acheranthi*, described herein are new to science

77. Some tingids of economic importance from Delhi State.

M G. RAMDAS MENON and S. AFSARUL HAKK, New Delhi.

Observations carried on about the damage done by Tingids to plants of economic importance in Delhi State showed that there are seven species which are injurious to cultivated plants. The nature of damage differs in case of each species. A varietal resistance has been noted in case of brinjal plants (*Solanum melongena* L.) against the brinjal tingid, *Urentius, echinus* Distant. The insect predators and parasites have been noted down, which have been found exercising a natural check over the multiplication of tingids. The control methods adopted, to combat the tingid pests have been described separately.

The incidence of the seven important tingid pests in Delhi during the period October 1, 1957 to August 31, 1958, has been given.

78. A revision of the genus *Urentius* distant, with descriptions of five new species. (Heteroptera : Tingidae)

M. G. RAMDAS MENON and S. AFSARUL HAKK, New Delhi.

Genus *Urentius* Distant of the subfamily Tinginae of the family Tingidae (Hemiptera . Heteroptera) has been completely revised as it exists now in the world. This genus contains eleven previously recorded species, out of which five have been described from the Indian region (Ceylon included), i.e , *U. echinus* Distant, *U. euonymus* Distant, *U. maculatus* Drake, *U. olivaceus* Distant and *U sentis* Distant; three from Egypt, i.e., *U abutilinus* Priesner and Alfieri, *U. aegyptiacus* De Bergevin, and *U. hoggari* De Bergevin; one from Australia, i.e., *U. sainae* Hacker; one from Galia mer., i.e., *U. chobauti* Horvath; and one from Transvaal, i e., *U. vepris* Drake The authors have added five (5) more species by name *U. euphorbiae*, *U. indicus*, *U. pusaensis*, *U. sidae* and *U. zizyphifolius*, from the Indian region, which are new to science, with a dichotomus key for their ready separation

79. Studies on Indian meenoplidae (Homoptera : Fulgoroidea).

RAMDAS MENON and M. A HOLKAR, New Delhi

Seven species of Meenoplidae under four genera have so far been recorded from the Indian Union The authors have been able to add two new species from Delhi to this list, which are described as *Anigrus delhiensis*, sp. nov. and *Meenoplus indicus*, sp. nov This is the first record of the genus *Meenoplus* from the Oriental Region. A full account of the Indian Meenoplidae, including descriptions of the new species, is given in this paper

80. Histochemical studies on the different castes of the termite, *Odontotermes redemanni* (Wasmann).

DURGADAS MUKHERJI and BARUNDEB BANERJEE, Calcutta

Comparative histological observations of different castes of the termite have been supplimented by the histochemical observations on the localization of some of the important enzymes The localization and the concentration of the enzyme, Alkaline phosphatase, has been determined in the different regions of the gonads and gonoducts of the alate and de-alate sexuals. Interesting reactions for the enzyme have been observed in the ovarioles and the testicular cells of the sexuals, where positive results have been noted. The observations for the enzyme have also been extended to the different regions of the digestive tracts of the worker, soldier and fertile sexual castes. Determination of the enzyme Acid phosphatase in different histological regions of all the castes has also been undertaken. In most cases higher concentration of Alkaline phophatase, than the Acid phophatase has been observed

81. Post-treatment temperature coefficient of insect susceptibility to insecticidal films.

S. PRADHAN and N. R. ANANTHAKRISHNAN, New Delhi.

During these investigations the test insect *Tribolium castaneum* adults were preconditioned for twentyfour hours at 25°C. and then made to crawl on the insecticidal films of different strengths for a specified period (2 hrs. for DDT, BHC, aldrin, dieldrin and 4 hrs. for toxaphene) and then transferred to clean containers and kept without food at various post-treatment temperatures for observations. The mortality counts were taken at 24 hrs. interval up to a period of 3 days. The data thus collected 72 hrs. after exposure to the films were subjected to probit analyses and the calculated values of $L.C._{50}$ are tabulated.

82. Relative toxicity of insecticidal films to the just hatched larvae of cotton pink Bollworm (*Platyedra gossypiella* Saund. gelechiidae, lepidoptera).

S. PRADHAN and M. N. BORLE, New Delhi.

The preliminary observations on the habits of just hatched larvae of *Platyedra gossypiella* Saund. showed that practically all of them wander about on the surface of the cotton plant for a minimum period of 20 minutes before entering into the plant tissue. Hence during these experiments these just hatched larvae were made to crawl for 20 minutes on films of different strengths of eight different insecticides Thereafter they were removed from the films to clean containers and reared firstly on cotton leaves and then on sprouted beans under laboratory conditions.

Mortality counts were recorded at intervals of 24 hours and data thus collected 72 hours after exposing the larvae to the insecticidal films were subjected to probit analysis.

Observations on the development of the treated larvae that survived the treatment gave an indication that the larval periods get somewhat reduced except in case of DDT, and pupal period slightly increased, sex ratio gets disturbed in favour of larger number of males and fecundity of the females somewhat decreased.

83. Relative toxicity of insecticidal sprays to fourth state hoppers of *Locusta migrateria* Linnaeus.

S. PRADHAN and P. B. SUCHAK, New Delhi.

This paper reports the result of investigation carried out to determine the relative toxicity of eleven insecticides used as direct spray against fourth stage hoppers of *Locusta migratoria* Linnaeus. The insecticides were formulated as emulsions of different strength using benzene as solvent and Triton X-100 as emulsifier so that the concentraton of the solvent and the emulsifier in the final dilutions ready to be sprayed were 5% and 0·5% respectively. About 30 seconds after spraying the hoppers were removed to clean containers and given fresh maize leaves The mortality counts were recorded 24 hours after treatment and the data thus collected analysed for 72 hours after treatment were subjected to probit analysis. The relative toxicity of the various insecticides was found to be, endrin> aldrin> Chlorane> dieldrin> isodrin> lindane> malathion> P—P′ D.D.T.> Systox> Diazinon> Texaphane.

84. Studies on the digestive organs of *Dalpada versicolor* Herr-sch. (Pentatomidae : Heteroptera)—Part II. Morphology of the Digestive organs.

S. C. RASTOGI, Pilani.

The digestive tract of the bug, *Dalpada versicolor* confirms to the general heteropteran pattern. The alimentary canal is divisible into *foregut, midgut* and the *hindgut.* The foregut consists of a cibarium, pharynx and an oesophagus. The oesophageal epithelium has cuboidal cells and chitinous intima. The muscularis occurs as an internal circular and external longitudinal muscles. The oesophageal valve is a well defined double walled structure. The midgut is differentiated into four stomachs, the 4th being provided with four rows of pink coloured hepatic caeca. The midgut epithelium is composed of columnar cells and both mesocrine and holocrine secretions have been noticed. No peritrophic membrane was noticed. The ileum or the 'pylorus' is oval and four coiled malpighian tubules open in it. The wall of the ileum is folded with columnar cells. The rectum is thin walled and the epithelium is folded irregularly. A folded and tough chitinous intima lines the rectal lumen. No rectal pads or papillae have been observed.

The salivary glands consist of a pair of principal and a pair of accessory glands. The salivary ducts have thick chitinous intima

85. A study of the female genitalia and abdomen of *Sphaerodema rusticum* Fabr. (Belostomidae).

S. C. RASTOGI and R. KUMAR, Pilani.

The paper describes some interesting features in connection with the abdomen and female genitalia of *Sphaerodema rusticum* Fabr. Densely setose structures are present on the ventral side of the abdomen. In addition to their probable sensory function, they might be assisting copulation.

The ovipositor, which is completely retracted in the *vestibulum*, is composed of two pairs of unequal *valvulae*. The 2nd pair of valvulae are *hinged* to their *valvifers* and at rest they form a cross. The tips of the 2nd pair of valvulae are characteristically hooked. An interesting feature is the presence of paired hairy club-shaped *styli*. Each of the two coxopodites of the 9th segment is divided into an anterior plate, the valvifer bearing 2nd valvula and posterior plate supporting the stylus. The two styli in this case are well developed in contradistinction to other pterygote insects except some Odonata. The absence of a 3rd pair of valvulae and the extremely unequal development of 1st and 2nd pairs of vavulae point towards a departure from the structure of a generalised pterygote insect. The styli recall the Thysanuran, *Thermobia* (Snodgrass, 1935) where similar styli are present.

86. Aphids of Rajasthan.

D. N. RAY CHAUDHURI and A. K. GHOSH, Calcutta.

Seven species of aphids belonging to five genera are recorded from Western Rajasthan for the first time. These are *Aphis craccivora* Koch, *Aphis gossypii* Glover, *Aphis nerii* Boyer, *Brachiunguis* sp., *Liphaphis erysimi* (Kalt), *Macrosiphonelilia sanborni* (Gill.), *Myzus persicae* (Sulz.). Most of the species were collected from *Calotropis gigantia* which occurs in plenty over there, but *Aphis gossypii*, *Liphaphis erysimi*, *Myzus persicae* are regarded as migrant forms from surrounding cultivated areas. *Aphis craccivora* Koch. is for the first time recorded from *Calotropis*.

87. Abnormal antenna in culicoides (Diptera : Ceratopogonidae).

P. SEN and S. K. DAS GUPTA, Calcutta.

The paper records three instances of anomalous antennae in *Culicoides alatus* out of a total of 850 individuals examined. The specimens showing the abnormalities were collected with the others in light traps from Calcutta and surroundings. Abnormalities noticed are in the nature of reduction in the number of segments in the antenna in two females and in the reduction in length of terminal segments of this organ in one male specimen. The abnormal conditions affect the flagellar ratio. Distribution of hairs and spines was normal in all, but the disposition of sensoria in antennal segments was abnormal in one instance. As similar abnormalities were noticed in about 0·4 per cent individuals of the species in random sampling these are not likely to affect the taxonomic interpretation in the group.

88. On determination of age in the biting midges *Culicoides alatus* (Diptera: Ceratopogonidae).

P. SEN and S. K. DAS GUPTA, Calcutta.

The paper deals with the determination of age-groups in biting midge *Culicoides alatus*. The investigation is based on the examination of abdominal conditions of 1528 females collected by light trap for 21 nights. Four distinct categories were seen (1) individuals unfed or fed on plant sap with immature eggs (46·9%), (2) individuals blood fed with immature eggs (37·4%), (3) individuals with mature eggs (12·6%), and (4) individuals after egg-laying (3·1%). Light traps have proved an efficient means of collecting individuals of different age-groups

89. A few interesting points on the study of Labrum and Labium in *Dysdercus cingulatus* (Heter.) Pyrh.

YATINDRA KUMAR RATHORE, Agra

1. In the labral groove there is a well chitinised mid-ventral, finely striated labral plate which is pushed inwards by the inturned margins of the dorsal wall of the labrum The flexibility of the labrum is perhaps gained by this plate.

2. The labium is four segmented and is provided with labial plate which is membranous at the joints. It extends proximally in a basal plate inserted below the clypeus.

3. There is a dorsal basal in the labial plate which acts as hinge for the labial movements.

4. The first elbow joint is provided with an elbow plate and the second elbow joint has a labial fossa covered by a membrane.

5. The tip of the labium is notched ventrally and is provided with sensory hair.

6. The first labial segment has a pair of ventrolateral 'Extrinsic Adductors' for folding the labium abreast; a pair of dorsolateral 'Intrinsic Abductors' for extending the labium; and an oblique median 'Intrinsic Extensor' to straighten the first elbow joint.

7. The second segment has a pair of 'Second intrinsic extensor' to straighten the second elbow joint and an oblique 'Median Flexor' to bend both the elbow joints.

8. The third segment has an 'Abductor' and an 'Adductor' of the fourth segment.

9. There are no transverse muscles in third or fourth segment. The fourth segment is totally devoid of muscles.

10. The confusion regarding the working of the muscles has been cleared by preparing a working Bamboo Model.

90. Notes on the structure of the Pylorus and Pyloric valve of *Aulacophora*.

R. S. SAINI, Saugor.

In *Aulacophora* the hindgut is divisible into four regions : pylorus, ileum, colon, and rectum. Externally, the pylorus seems to arise immediately behind the origin of the anterior set of two malpighian tubules, while its posterior limit is marked by the origin of the common stalk of the posterior four malpighian tubules and it is from the pylorus that the posterior set of four malpighian tubules arises. The pyloric valve is a proctodoeal valve and the wall of the hindgut projects in the midgut. The cell boundaries in the pylorus are distinct and cells are cubical with large rounded nuclei.

91. Orientation and feeding behaviour of *Oxycarenus* byalinipennis (Costa) on cotton plant.

K. N. SAXENA and S. S. KRISHNA, Delhi.

There is a divergence of opinion on the economic status and site of feeding of *Oxycarenus*, a pest of cotton. Many workers regard this insect as a serious pest of cotton feeding and damaging the seeds; others believe that it feeds on other parts of the plant as well. These reports are based on insufficient experimental evidence. Since the injury caused by *Oxycarenus* is related to its feeding behaviour, experimental investigations have been undertaken to study the relative preference of the pest for different parts of the cotton plant and also to determine the factors governing the establishment of the pest on the host plant. The data have been subjected to suitable statistical analysis.

It has been experimentally shown that both nymphs and adults show greater preference for the opened cotton bolls and for the leaves than for other parts. The insects congregate on open bolls partly for feeding, partly for oviposition but mainly for rest. For the purpose of feeding, the insects show greatest preference to cotton leaf or epicalyces; next in order come green bolls and flowers, and seeds come last.

Factors governing orientation and feeding behaviour of *Oxycarenus* on cotton plant have also been experimentally determined. Thigmotaxis coupled with phototaxis guides the insect to the opened cotton boll. Hydrotaxis coupled with phototaxis guides the insect to green parts of the plant like leaf, epicalyces of the green parts and green bolls. Saccharotrophism is responsible for their feeding activity. Relative preference of the insect for different parts of the cotton plant for the purpose of feeding are in direct relation to the concentration of sugars present in those parts.

92. Occurrence of the Indian pea-leaf miner *Phytomyza atricornis* Meigen (Agromyzidae, Diptera) at Pilani (Rajasthan).

T. R. SHARMA, V. K. DATTA GUPTA and H. L. KUNDU, Pilani.

The Indian pea-leaf miner *Phytomyza atricornis* Meigen (Agromyzidae, Diptera) has been reported for the first time from Pilani. 35 species of host plants were recorded out of which only 11 species were reported by earlier workers.

The process of tunnelling by the newly hatched larvae and the nature of damage caused by them have been studied. The direct effect of tunnelling is the loss of the chlorophyll-bearing tissue of these plants. Infestation is more heavy upon the foliage in shade and mature larvae appear to be negatively phototropic.

Most of the host-plants are either herbs or mesophytes while the xerophytes are free from such infestations. Perhaps the nature of the cuticle plays a vital role in determining the susceptibility of the plant to the pest.

93. Campaniform sensilla and their possible value as a supra-specific character in avian mallophaga.

B. K. TANDAN, Lucknow.

The presence of campaniform sensilla on the trochanter of the legs of avian Mallophaga is reported and it is suggested that their numbers and distribution may be of supra-specific value.

94. The second thoracic spiracle in *Apis* (Hymenoptera : Apidae).

G. T. TONAPI, Poona.

Examination of the second thoracic spiracles of the oriental species viz. *Apis indica* Fabr., *A. florea* Fabr., and *A. dorsata* Fabr., has revealed some interesting features. A complete illustrated description of the second thoracic spiracle of the workers of each species is given and those of the other castes are dealt by comparison. The details of the measurements of the posterior thoracic spiracles with their associated structures have shown that these are not significantly smaller in size as compared to the anterior thoracic spiracles. An irregularly sclerotised and roughly circular collar is usually present. A well defined peritreme of variable shape also occurs. Distinct atrium is also present in some of the species studied. A single trachea leaves each spiracle and a strongly sclerotised and curved calliper or an elongate elastic tendinous ring is situated between the atrium and the tracheal opening.

95. On the respiratory system of the male of *Dorylus labiatus* Shuck.

G. T. TONAPI, Poona.

The respiratory system of the male of *Dorylus labiatus* Shuck. is described. The anterior and posterior thoracic spiracles have an acicular occlusor and fan-shaped occlusor muscle respectively. Each of the propodeal and gastral spiracles is provided with a cylindrical occlusor muscle and a similarly shaped dilator muscle. The tracheal system consists of an elaborate system of air-sacs. The cephalic respiratory system consists of ocellar sac, cerebro-optic sac, ocular sac, frontal sac, lateral sacs, mandibular sacs and sub-oesophageal sacs. The thoracic respiratory system comprises of lateral thoracic sacs, pronotal sac, mesoscutellar sac, scutal sac, dorsal muscular sac, dorsal and ventral propodeal sacs. The gastral respiratory consists of two enormously large air-sacs with segmental dorsal and ventral saccular anastomosis. The results are compared with those of other Hymenoptera. It is doubtless that there exists a close relationship between the development of number and/or size of air-sacs and the size of the body or its parts. So far as adult Hymenoptera are concerned it appears that the body size influences the development of internal tracheal system.

96. On the organs of sound production in the two species of cicadas (Homoptera-Cicadidae).

G. T. TONAPI, Poona.

In *Platypleura octoguttata* Fabr. each sound producing organ is situated in the ventral and lateral cavities formed by an infolding of the body wall and is protected by paired opercula. The walls of these cavities are specialised membranous areas. The muscles involved are the tymbal muscles, the tensor muscles and the dorsal muscles. The detensor muscles keep the tympanic (auditory) membrane stretched and tense. The remaining abdominal muscles viz. the dorsal longitudinal abdominal muscles, the ventral longitudinal abdominal muscles and the lateral longitudinal abdominal muscles contract and relax the abdomen. A pair of large abdominal spiracles with structure resembling the thoracic spiracles are present and each is connected with the large abdominal air-sacs of the respective side. The sound producing apparatus of *Lethama locusta* (?) Walk. is also described in detail. Some of the significant anatomical differences in the structure of sound producing and receiving apparatus of these two different cicada genera are pointed out.

97. The skeleto-muscular system of the thorax of the lemon butterfly, *Papilio demoleus* (Lin.).

SHOBHA VASUDEVA, Delhi.

A study of the skeleto-muscular system of the thorax of *Papilio demoleus* reveals many interesting features. The skeleton of the pro-, meso- and metathorax are described in detail, together with the nature of the sclerites of the notum, pleuron and sternum.

The fusion of the episternum with sternum of the mesothorax to form the sterno-pleural plate is characteristic of *P. demoleus*.

The *musculature* of the pro-, meso- and metathorax regarding their attachment and insertion, has been worked out in detail.

VII. FISH AND FISHERIES

98. On the stomach of the Milk-fish *Chanos chanos* (Forskal).

M. CHANDY and M G GEORGE, Delhi.

The stomach of *Chanos* is comparatively large and occupies a major portion of the digestive tract. It is thrown into several folds, and has two distinctive regions, the anterior cardiac and the posterior pyloric or gizzard.

Histological studies show that the wall of the cardiac stomach has in addition to the usual layers, a massive glandular layer, which occupies double the width of the muscular layer. The wall of the gizzard is chiefly made up of the circular muscle layer which assumes an enomous proportion. Inner to this lie the mucosa and a layer of stratified epithelium which gives rise to the cuticle.

The food of adult *Chanos* consists of an admixture of plankton, lamellibranchs, lot of sand grains and the particles.

Another interesting feature is the complete absence of a cuticle in the gizzard of young ones and fingerlings which feed on diatoms, nomatodes and crustacean larvae. The addition of a cuticle in the gizzard of adult *Chanos* is a subsequent adaptation when the change over takes place to a harder type of food.

The anatomy and histology of the stomach of *Chanos* reveals the profound modifications undergone by this organ.

99. A Comparative Investigation of the Growth Rate and of the Biochemistry of the Blood Proteins of the Indian Carp.

B. C. DAS, Calcutta.

In order to determine the differential growth rate of Indian carp, and the comparative biochemical picture of their blood proteins, the present research investigation was taken up. To obtain information on the differential growth rate, samples of carp from a population of known age were weighed at regular intervals over a fifteen month period. A second degree polynomial was fitted to the growth data over time, using the logarithm of the carps' weight. For *Catla catla*, the required equation was :

$$\log_w = 0{\cdot}954457 + 0{\cdot}006584\,t - 0{\cdot}00001123\,t^2.$$

For *Labeo rohita*, the equation was :

$$\log_w = 0{\cdot}821474 + 0{\cdot}004377\,t - 0{\cdot}00000934\,t^2.$$

For *Catla catla*, *Cirrhina mrigala*, and *Lebeo rohita*, biochemical analyses of the blood were carried out for blood sugar, total protein, serum protein, lipo-protein, and hemoglobin. Blood sugar and total blood protein were estimated by chemical methods, and serum protein, lipo-protein, and hemoglobin were analysed by means of agar electrophoresis. Qualitative evaluation of the electrophoretic pattern of hemoglobin showed that *Catla calla* has two bands, while *Cirrhina mrigala* and *Labeo rohita* have only one band each. One lipo-protein fraction, α_F , was found in *Cirrhina mrigala* but was absent in *Catla calla* and *Labeo rohita*. Nineteen additional quantitative biochemical measurements were made, and by statistical analysis of variance it was shown that there were significant differences between *Catla calla*, *Cirrhina mrigala*, and *Labco rohita* on the following eleven : blood sugar; percentage values of the serum protein fractions α_1, β and γ; percentage values of α and β lipo-protein fractions; actual values of serum protein fractions α_1, α_2, β and γ; and the actual values of β lipo-protein. Differences in final weight were also significant. Further studies investigating biochemical markers in relation to differential growth rate, comparing different species, are suggested.

100. Modifications of the swimbladder in the family Belonidae.

P. V. DEHADRAI and M. CHANDY, Delhi.

In genus *Belone*, the long tubular swimbladder swells in front, eventually giving rise to two anterior auditory caeca which establish the peculiar ear-swimbladder relation. The complex nature of it has been worked out in detail. In genus *Tylosurus*, the swimbladder extends anteriorly as a single median auditory caecum which gets attached with the auditory capsule at its right side. But in the genus *Xenentodon*, the ear-swimbladder relation does not exist at all.

The presence of gas-gland patches all over the inner surface of the swimbladder in genus *Belone*, makes the position of the oval enigmatic.

The importance of the structural diversity in the swimbladder of different genera of the family Belonidae, has been emphasised for its taxonomic value. The work clarifies many descrepancies and controversial accounts given by different authors on the swimbladder of the family Belonidae.

101. On the swimbladder and its connection with the internal ear in Cichlidae.

P. V. DEHADRAI and M. CHANDY, Delhi.

The paper is based on the detailed morphological and histological study of the swimbladder of genus *Etroplus* of the family Cichlidae. Work was also carried out on *Tilapia mossembica*, an African member of Cichlidae.

The swimbladder in genus *Etroplus* is supported by dorsal and ventral tendinous cords, which extend in front along with the forked anterior tubular auditory caeca and enter the auditory capsule in the form of tendinous pads. These pads fit smugly in the auditory fontanalle. The auditory caeca lie apposed to these pods and thus establish the ear-swimbladder relation which has been described for the first time. The dual function of the tendinous pads, which plug the auditory fontanalle, is explained.

Internally, the swimbladder is partitioned by a perforated diaphragm. The large thick walled anterior chamber lodges the gas-gland and retia mirabilia and serves as a secretory part. The posterior chamber, smaller and thin walled, is the seat of gas resorption. The probable significance of the intimate association between the gas-gland tissue and the smooth muscle layer, is that the smooth muscle layer could have a mechanical effect upon the release of gas bubbles.

The swimbladder in *Tilapia mossambica* is similar to that of genus *Etroplus* except that the anterior forked caeca in *T. mossambica* do not reach up to the auditory capsules and as such the ear-swimbladder relation is wanting.

The generic variations in the swimbladder may be of systematic value. The specific variations in the structure of the swimbladder within the genus *Etroplus* have been emphasised. It has been possible to amplify the description of the swimbladder of genus *Etroplus* given by Day (1889).

102. On the swimbladder and its posterior communication to the exterior in *Ilisha indica* (Swainson).

P. V. DEHADRAI and M. CHANDY, Delhi.

The peculiar features in the structure of the swimbladder in *Ilisha indica* (Swainson), have been described in detail.

The presence of a pair of small, filiform anterior caeca is characteristic of *I. indica*. The posterior portion of the swimbladder descends downwards as a tubular structure which eventually opens to the exterior near the vent, behind the openings of the alimentary canal, the gonadial duct and the urinary bladder which are placed in a series from front to behind.

The tunica interna near the posterior opening, is modified to form a thick, muscular, vermiform appandage, opening to the exterior.

The muscularis mucosa in the tunica interna of the swimbladder wall is disposed into deep folds the function of which is obscure.

A complete morphological and histological study of the posterior communicating mechanism in the swimbladder of *I. indica* has been elucidated for the first time. The function of a safety valve has been attributed to the posterior muscular appendage of the swimbladder.

The anus, the gonadial duct, the urinary bladder and the swimbladder in the region of the vent maintain separate identity and exact position of their independent openings have been confirmed. All the four openings in the region of the vent are surrounded by soft connective tissue which, in no case, should be confused with the common sphincter muscle, as observed by Maier and Scheuring (1923).

103. On the breeding migration of *Mugil cephalus* Linnaeus from the Chilka Lake into the sea.

V. G. JHINGRAN, Balugan.

Mugil cephalus Linnaeus is the most important commercial mullet of the Chilka lake. A precise knowledge of the pattern of migration of this species is an essential prerequisite to formulate a conservation policy for its fishery. The present paper furnishes data and evidences to show that *M. cephalus* performs a regular migration to the sea from the Chilka Lake for breeding. These evidences fall under three categories viz. (a) Size-frequency distribution studies of the fish of known stages of maturity taken from the main area of the lake, the outer channel and from the sea adjoining the Chilka Lake mouth; (b) field observations of the actual act of migration and (c) other evidences bearing on the point.

104. Osteology of *Wallago attu* Bloch and Schneider, Part I. Osteology of the head.

C. MARY JOHN, Trivandrum.

A study of the skull of *Wallago attu* shows that the neurocranium is platybasic. Both the anterior and posterior myodomes are absent. The trigemino-facial chamber is reduced to a foramen and the pars ganglionaris is represented only by a spacious depression on the anterodorsal aspects of the prootic. The rostral, parietals and basisphenoid are apparently absent. The supraoccipital does not contribute to the foramen magnum.

There is no temporal fossa but the posttemporal arcade is represented by the posterior supraoccipital ridge. The relationship of the ophthalmicus profundus to the lateral ethmoids and the vestiges of the orbitonasal and spiracular canals are reported here for the first time in the Siluroidei.

The posterior firm interdigitation of the lateral ethmoids with the sphenotics seems to be a primitive feature. There is a firm articulation between the prevomer and the lateral ethmoids. The orbitosphenoid is not tubular. The reduction in the size and number of the pterygoids and the nature of the articulation of the octopterygoids to the surrounding bones seems to be a measure of evolution in the Siluroidei.

In the visceral skeleton, the maxillaries support the maxillary barbels. The palatines are reduced. The premaxillaries stop far short of the angle of the mouth. The symplectics and basihyal are absent. A comparative study seems to indicate that the bones carrying the dorsal patches of pharyngeal teeth are the fourth pharyngobranchials.

105. *The Development of chondrocranium in Nerophis* (Lophobranchii).

K. M. KADAM, Bangalore.

The development of the chondrocranium of *Nerophis*, a syngnathid from the Swedish waters has been studied. In the earliest stage studied (5·0 mm. embryo) the trabecula communis is already formed and there are indications that it has arisen as a median structure. In later development the trabecula communis becomes greatly elongated and gives rise to the ethmoid plate which is bent on itself. The straightening of the ethmoid plate occurs during further development. The nasal septum and lamina orbitonasales arise late in the development independently of the ethmoid plate and fuse with the latter later. There are no roofing cartilages in the skull except for a short vestige of the taenia tecti medialis in the anterior region of the auditory capsule and a narrow tectum posterius in the occipital region. There is only one cartilaginous septum in the otic capsule. Meckel's cartilages which are vertical and somewhat tilted backwards in the early stages incline forwards as the ethmoid plate becomes straightened up. In the branchial skeleton the branchial arches are reduced and the fifth arch does not develop at any stage.

106. Observations on the food and feeding habits of the Indian whiting (*Sillago sihama*, Forskal) from Karwar waters.

V. C. PALEKAR and D. V. BAL, Bombay.

Observations on the food and feeding habits of the Indian whiting (*Sillago sihama*) have brought out certain interesting features. The fish is purely non-vegetarian. The post larval and the juvenile fish below 100 mm. total length were noted to consume planktonic forms like the Mysis, Leucifers, Copepods, Cypris, post-larval lamellibranchs etc. ·On the other hand, the adults subsist on 3 types of food-items, viz., Polychaetes (neried worms), Lamellibranchs (clams) and the Crustaceans like prawns and crabs, all of which denote that the fish is a bottom feeder. The data collected over a period of about two years, has been analysed to indicate the fluctuations in the composition of the main food items, their prevalence during different months and size classes, and the probable influence of maturation on feeding of the fish.

The food of the post-larval and juvenile fish clearly shows that the fish is pelagic in habitat during this phase of life, while the food of the adult indicates a more or less demersal habitat, the adults exclusively resorting to bottom feeding.

The adult *Sillago* consumes Polychaets, Lamellibranchs and Crustaceans in more or less uniform proportions, with a greater preference to the first two items. The fish shows rather uniform and moderate preference to Polychaetes at all sizes of the adults; but while the preference to Lamellibranchs is indicated by an ascending trend, that to crustaceans shows a descending trend, with the growth of fish in length. During the early maturation period i.e. upto III stage, the intake of the three main items of food appears to be relatively uniform, indicating normal feeding of the adult. In the later stages of maturation, the fish seem to consume Polychaetes and Lamellibranchs only, with little preference for crustacean diet.

107. A Preliminary Account of the Fishery and Biology of Silver Pomfret (*Pampus argenteus* Euphrasen).

M. S. REGE and D. V. BAL, Bombay.

This important fishery along the Bombay Coast has not received the attention it deserves. The fishing season for Pomfrets along the Bombay Coast starts immedately after the S.W. monsoon and continues for major period of the year, bringing considerable returns to the fishermen and the fish merchants. Porbunder, Mangrol, Veraval (belonging to the old Saurashtra State) and Satpatti, Bassein, Versova, Revdanda and Alibag (belonging to the old Bombay State) are some of the main ports where these pomfrets are regularly landed. The gear used for trapping the fish is, however, not uniform at all these places. The food of pomfrets seems to consist of salpa and Hydro-medusae. A study of maturify and spawning of the fish along the coast reveals that the fish spawns only once a year, during a short restricted period. This period of spawning was observed to be from October to December for samples from Satpatti and April to June for samples from Veraval, indicating the possibility of two or more stocks of pomfrets along the coast which spawn at different times of the year. Results obtained from a preliminary study based on the morphometric analysis of samples from some of the important fishing ports along the coast tend to support this contention strongly.

108. The skull of *Mystus (Osteobagrus) seenghala* (Sykes).

H. L. SARKAR and HAKUMAT RAI, Delhi.

In the skull of *Mystus* the cranium is long, granulated, dorso-ventrally compressed with a gradual slope from behind forward. The width of the skull is more or less uniform throughout. Bifiid process of the supraethmoid, projection of the ectoethmoid and the supraoccipital process are prominent. The roof of the cranium is incomplete due to the presence of two fontanelles. The ventral surface of the skull is smooth and is more or less in the horizontal axis.

Posterior portion of the roof of cranial cavity is formed by the supraoccipital. The foramen magnum is formed by the two exoccipitals. The basioccipital has an oval concave occipital condyle for the articulation with the first compound vertebra. Number of posteriorly directed processess are given out from the ventral surface of the basioccipital. At a posterolateral angle of the skull the supratemporal forms the roof of the supratemporal fossa. The parietal is absent. Besides prootic, epiotic, and sphenotic, squamosopterotic is also present as in other siluroid fishes. The opisthotic is absent. The orbitosphenoid, parasphenoid and alisphenoid are present but the basisphenoid cannot be distinguished. The vomer has wing-like expansions and bears finely granulated inconspicuous teeth. The nasal bone is tubular and lies on the side of the supraethmoid and is not directly articulated with the cranium. Five orbital bones form the orbit and the lacrymal also belongs to the series of the orbital bones, and the entire series is connected with the lateral line canal. Palatine is rod-shaped and lies parallel to the long axis of the skull and has lost its direct attachment with pterygoquadrate. The metapterygoid has no direct connection with the hyomandibular. Quadrate articulates with the hyomandibular and inner side of preopercular bone.

Premaxilla is with blunt villiform teeth. Maxilla is very much reduced and acts as a basal support of the maxillary barbel. The lower jaw comprises only the dentary and articluar, and there is no separate angular. Meckel's cartilage is present on the inner surface of dentary and articular.

109. Sexual dimorphism in *Garra lamta* (Ham. Buch).

DEEN DAYAL SONI, Sagar.

Garra lamta shows well marked sexual dimorphism. This is specially noticeable in the character of the snout. In the male, there is a well developed deep transverse groove immediately anterior to the nostrils, while in the female this groove is represented by a hardly recognisable shallow groove. Moreover, in the male, both the dorsal as well as the lateral sides of the head are provided with numerous fine pores; in the female, however, these pores are considerably fewer in number.

110. Early development of the chondrocranium in 4·5 mm. embryo of *Garra lamta* (Ham. Buch.).

DEEN DAYAL SONI, Sagar.

At this stage the trabeculae are represented by procartilage but the parachordals and the auditory capsules are represented by aggregation of loose mesenchyme cells only.

In the splanchnocranium the Meckel's cartilage, the ceratohyals and ceratobranchials of the first branchial arch are represented by procartilage.

In the region of the parachordals, the loose mesenchyme cells are attached to the notochord posteriorly, but diverge away from the latter anteriorly. In the region of the auditory sacs, the mesenchyme cells of the parachordals and of the auditory sacs are continuous with one another.

Anteriorly the trabeculae are represented by procartilages which start from the anterior end of the parachordal cell aggregations at the level of the anterior end of the notochord and stop just behind the optic nerve.

111. Development of skull in Catfishes. Part III. The development of chondrocranium in *Heteropneustes fossilis* (Bloch), (Heteropneustidae) and *Clarias batrachus* (Linn.), Clariidae.

H. R. SRINIVASACHAR, Bangalore.

Eleven stages in the development of the chondrocranium of *Heteropneustes* and six stages of *Clarias* have been studied.

In the 3 mm. stage of *Heteropneustes*, the parachordals appear and the trabeculae are still procartilaginous being in contact with the mesenchyme anteriorly. In the 3·5 mm. stage, trabeculae have fused with the parachordals; the rudiments of auditory capsules, Meckel's cartilages and the quadrate-hyomandibular piece of cartilage have developed. In the 5·0 mm. stage the rudiments of the lamina orbitonasalis anteriorly and those of the occipital arches posteriorly are noticed. A sphenoid fontanelle for the exit of the branches of trigeminal and facial nerves, is developed in the 6·0 mm. stage. In the 12 mm. stage the lamina precerebralis has developed and the olfactory foramen is seen on either side of the ethmoid region. The quadrate-hyomandibular cartilage shows an anterior extension in line with the pterygoid process representing the processus pterygoideus of the quadrate. The chondrocranium is fully formed in the 17 mm. stage. The lamina precerebralis is considerably developed forming the anterior boundary for the cranial cavity and shows anteriorly the ethmoid cornua. Two foramina are noticed in the lamina orbitonasalis; the dorsal one is for the exit of ophthalmic branch of the trigeminal nerve and the ventral one is for a blood vessel. The olfactory foramen is much reduced when compared with the other siluroids studied. The orbital cartilages are extensive and an epiphysial bar is absent. The tectum synoticum is continuous with the tectum posterius of the occipital arches. The glossopharyngeal nerve gains separate exit. In the branchial arches, the pharyngobranchs are absent in the first two branchial arches, whereas in the third and fourth arches, the pharyngobranchs are noticed as fused piece of cartilage on each side.

In *Clarias* the development of chondrocranium is almost similar to the one described in *Heteropneustes*. The fully formed chondrocranium of *Clarias* differs from that of *Heteropneustes* in number of characters and these have been discussed in the paper.

112. Studies on the wild mammals of Orissa : I. Distribution.

B. K. BEHURA, Cuttack.

In order to device suitable measures for the preservation of wild animals in any State, it is necessary to know the distribution and population of different species in the different areas of the province. A list of forty-one species of wild animals of Orissa together with their local names in Oriya and zonal distribution in the State are given together with a map. The swamp deer, *Recurvus duvaucelli* Cuv. previously restricted to the district of Sambalpur has become extinct due to ruthless killing. The black panther, *Panthera pardus negri* is found in the districts of Ganjam, Koraput and Kalahandi only, while the common form, *P. pardus* is met with in all districts. The wild buffalo, *Bubalus bubalis* L. is restricted to the districts of Koraput and Kalanhandi. The Indian bison, *Bibos gaurus* Smith is distributed in all the districts of the State. The blackbuck, *Antilope cervicapia* (Linn.) is confined to the districts of Puri, Ganjam and Balasore and have become rare in Kalahandi. The four-horned antelope, *Tetraceros quadricornis* (Blainv.) has so far been reported from the districts of Cuttack, Puri and Sambalpur. The elephant, *Elephas maximus* inhabits the forests of Mayurbhanj, Keonjhar, Dhenkanal, Ganjam, Phulbani, Puri and Sambalpur.

VIII. GENERAL

113. Observations on the Behaviour of some land and aquatic leeches.

BANSIDHAR BHATT, Delhi.

Behaviour of the land leech *Haemadipsa zeylanica agilis* (Moore) and the aquatic leeches *Hemiclepsis marginata marginata*, *Glossiphonia weberi*, *Dinobdella ferox* and *Hirudinaria granulosa* towards light, temperature and victim has been studied. The land leech *Haemadipsa zeylanica agilis* moves away from light in straight line making an angle with the straight line drawn between the source of light and the original position of the leech. This type of negative phototactic response was shown by average and large-sized, hungry and moderately fed leeches. Heavily fed leeches are generally sluggish and respond too slowly to changes in direction and intensity of light. When a leech moves away from a source of light and a second light is also put on, the moving leech changes its direction of repulsion. This new direction is the resultant of the direction of two lights at the new position of the leech. Small and unfed leeches, however, get attracted by the lights of low and high intensity. This positive phototactic behaviour of small and starved leeches may be due to their hungry state and a desire to get food.

Aquatic leeches, whose behaviour was studied, do not respond to light as quickly as the land leeches. Greater sensitivity of land leeches to light in comparison with aquatic leeches can be attributed to the presence of large eyes and extra-ocular photoreceptors in the former. The presence of extra-ocular photoreceptors has been recorded in the land leech *Haemadipsa zeylanica agilis* (Moore) by Bhatia (1956).

Haemadipsa zeylanica agilis shows maximum activity at 25°C. Below 12°C it becomes sluggish, but can survive at as low a temperature as 0°C for about 18 hours. If kept at such low temperatures for longer time it dies, particularly when water around it freezes.

Land leeches, which are close to their victim, are attracted by the breath. Vibrations and warmth are the factors in the breath which activate the leeches and presence of smell in the breath is responsible for their attraction towards the victim.

114. Zonation of intertidal organisms on a sheltered shore in Bombay.

Y. M. BHATT and D. V. BAL, Bombay.

An attempt is made in the zonation of the intertidal organisms based on a systematic study made at Cuffe Parade. The study has revealed that on the basis of the vertical distribution of the intertidal fauna, four zones can be recognised at Cuffe Parade, viz., Littorinid Zone, Balanoid Zone, Oyster Zone and Trochid Zone. In the classification of the zones the dominant animal form has been taken into account. This zonation compares favourably with Stephen's system of the zonation of rocky coasts.

115. On the blood supply of rectum, urinary bladder, and lumbar regions in *Bufo melanostictus.*

G. S. GHOSH, Cuttack.

The absence of the posterior mesenteric, which is not of universal occurrance in *Bufo melanostictus,* necessitates the prominence of the rectal tributary, which is invariably present as the terminal branch of the anterior mesenteric. This terminology, anterior mesenteric as also posterior mesenteric may be better replaced by the nomenclature first mesenteric and second mesenteric respectively.

The lesser prominence of the invariably present lumbar arteries is correlated with the lesser exertion of the lumbar region. The origin of epigastric and hypogastric is not distinct. They are the forked members of a single vessel, termed vesiculo-abdominal by the author.

116. A technique for the decalcification of the skull of mammals for the dissection of the brain for morphological studies.

G. S. GHOSH and B. K. BEHURA, Cuttack.

Due to the extreme hardness of the mammalian skull much difficulty is experienced in dissecting out the brain nicely and within a limited time for demonstrations in the undergraduate classes. The brain gets fixed and can be easily dissected out if the severed head of a guinea-pig with the skin intact is immersed in large quantities of a solution of 4% Formaldehyde 25 parts, 70% Alcohol 60 parts, Conc. Hcl 10 parts and 4% KOH 5 parts for three days. If the skin is removed from the severed head and the skull exposed before treatment with the liquid, the process of decalcification is still quicker. If the material is left in the solution for more than seven days, the brain gets damaged. The mammalian head after treatment with the fixing and decalcifying solution for three days is transferred to 70% Alcohol saturated with Lithium Carbonate and then can be left indefinitely in 70% Alcohol for dissection of the brain according to convenience.

117. "Contributions to the Systematics, Distribution and Ecology of the reptiles of the Rajasthan Desert, with special reference to lizards." Part II Fossorial habits.

DAYA KRISHNA and K. C. DAVE, Jodhpur.

The paper deals with the detailed study of the plan and mode of digging of the burrows, the burrowing habits and the conditions inside the burrows of certain lizards viz., *Mabuya macularia* Blyth, *Ophiomorus tridactylus* Blyth, *Uromastix hardwickii* Gray and *Varanus griseus* Daudin. The field observations have been supplemented with those in the captive and semi-captive conditions.

In nature the burrows of *Mabuya* are generally found near bushes in compact soil, and those of *Uromastix* are found in open fields of hard soil. The tunnels of *Varanus* are invariably found on compact sand near bushes. *Ophiomorus*, the sand-fish, live buried in loosesand. They remain under the sand for most of the time and come out for food only in the night. *Mabuya, Uromastix* and *Varanus* come out of their burrows in the day time, particularly in the morning and evening.

There is no definite walled burrow of *Ophiomorus.* This skink can burrow at any point in the sand and remains buried in it.

The burrowing methods, equipment, and the mode of digging and shovelling the earth is different in different lizards though the snout and the fore limbs with their claws are the important digging organs in all the forms, except *Ophiomorus.*

In the latter the boring is done mainly by the snout assisted with the wriggling movements of the cylindrical body, limbs playing no part in digging. The subsoil temperature in the burrows was measured with the help of soil thermometer and thermocouple and it was found that the temperature in the burrows is considerably lower than on the surface in the summer, and higher in the winter. This subterranean mode of life probably helps the desert reptiles to avoid the extreme of climatic conditions and to escape from their enemies.

118. "Contributions to the Systematics, Distribution and Ecology of the reptiles of the desert of Rajasthan, with special reference to lizards." Part III Food and feeding habits.

DAYA KRISHNA and K. C. DAVE, Jodhpur.

This paper records, for the first time in India, the detailed investigations of the food and feeding habits of the lacertilians of the arid zone of Rajasthan. *Uromastix hardwickii* Gray, *Agama agilis* Oliver, *Mabuya macularia* Blyth, *Ophiomorus tridactylus* Blyth, *Varanus griseus* Daudin and *Varanus monitor* Linnaeus were chosen for the study. All these lizards are widely distributed in the desert, and are found in abundance in almot all the seasons.

Feeding habits (the time, the mode of catching food and the mode of feeding) were observed in nature and supplemented with the observations in captivity and semi-captivity.

Uromastix is mainly herbivorous and rarely resort to other type of food in nature. They prefer grasses and seeds. *Agama* is essentially insectivorous and only in the absence of insects it turns towards the plant food, particularly leaves and buds. *Mabuya* and *Ophiomorus* are also insectivorous and prefer them under all conditions. *Ophiomorus* takes a good quantity of sand also with the food material. *Varanus griseus* and *Varanus monitor* are omnivorous. *Varanus griseus* prefers insects, small mammals and reptiles and eggs of birds and reptiles.

The lizards can remain without food for a long time. *Uromastix* and *V. griseus* can do without any food for years together. *Agama, Mabuya* and *V. monitor* can live without food only for 4-6 months. *Mabuya* and *Varanus* show some cannibalistic tendencies also, under a prolonged condition of starvation and during severe fights between them. *Varanus* often takes a good toll of the eggs of its own species.

In nature *Uromastix, Ophiomorus, Mabuya* and *V. griseus* do not drink water at all, even when it is available. *Agama* and *V. monitor* will drink the water whenever it is available. *Mabuya, Agama* and *Uromastix* have been observed licking the dew. In the captivity *Uromastix, Ophiomorus* and *V. griseus* did not drink water, whereas *Mabuya, Agama* and *V. monitor* licked the water. All these lizards except *Agama* and to a little extent *V. monitor* can live without water for a long time.

Vegetation and animals of the same region have also been studied in detail, as they are components of the food cycles and food chains of the various lizards.

119. Preliminary observations on the presence of epicuticle in the spider *Poecilotheria regalis* and its probable nature.

M. B. LAL and S. S. SHRIVASTAVA, Lucknow.

There has been some variation in the observations of Browning (1943) and Cloudsley-Thompson (1950a) regarding the presence of an epicuticle in spiders The present investigation reports the presence of a membranous epicuticle in the spider, *Poecilotheria regalis* (Pocock). Various histological and histochemical tests have been employed in the study of this layer. While histological picture is doubtful, histochemical reaction with concentrated chlorated nitric acid under cold, warm and hot conditions reveals the presence of a membranous epicuticle separate from and outer to the polygonal layer of exocuticle. This layer appears to be probably non-chitinous and hardened by aromatic cross linkages. The lipoids non-stainable with Sudan stains appear to be present. The sulphur bondage is absent.

120. Preliminary studies on the integument of the acarine *Trombidium grandisomum.*

M. B. LAL and S. C. SHRIVASTAVA, Lucknow.

Reference to a double layered composition of the cuticle of some German acarines is available in the works of Pegenstecher 1860, Croneberg 1879 and Henking 1882. Jones (1954), however, found that the cuticle in British acarines has five layers including a polyphenol layer and a wax layer in the epicuticle. The present investigation on *Trombidium grandisomum* reports the presence of only three layers fundamentally characteristic of the Arthropodan cuticle viz. the epicuticle, the exocuticle and the endocuticle. The absence of a polyphenol and a wax layer in the epicuticle is also demonstrated. The present investigation helps to elucidate further the details in the structure of the cuticle and reports the presence of prominent arborescent pore canals of scarlet colour visible in the fresh condition without any special demonstration and the lamellae. The red pigment imparting scarlet colour to the pore canals and to the bristles thickly beset on the cuticle and present as granules in the hypodermis, appears on a preliminary examination to be a carotenoid.

121. On the Anatomy of the cloaca of *Ptyas mucosus* (Linn.).

TRILOK MAJUPURIA, Shikohabad.

Much attention has not been devoted to the study of the anatomy of cloaca and copulatory adjustments in Indian reptiles. Microscopic anatomy reveals that the morphology and histology of cloaca in ophidia is quite specific in the whole group. The cloaca of *Ptyas* is a wide thin walled tube. The mucous membrane is impervious and regularly arranged with copious ramifications. The Coprodaeum is not sac-like as in *Uromastix.* The cloacal lumen of coprodaeum is not wide. A circular flexure separates the coprodaeum from other chambers. Coprodaeum communicate with the urodaeum by a narrow short connecting passage. Urodaeum is a spacious chamber. On the dorsal wall of urodaeum hangs a median longitudinal fold. The urogenital duct opens in the urodaeum towards the lateral side. The ureter opens ventrally into the hinder part of urodaeum, which is relatively short and narrow. The proctodaeum in male is hollow and lined by horny flattened epithelium. A strongly developed cloacal gland opens. This gland in section is found to be encircled by connective tissue. The epithelium of the proctodaeum is highly cylindrical and there are numerous mucilaginous cells in coprodaeum. The connective tissue of proctodaeum is reticulated and muscles are irregularly arranged.

122. On the Burrowing habits of the common Indian Mastigure, *Uromastix hardwickii* Gray.

TRILOK MAJUPURIA, Shikohabad.

Uromastix is usually found in soft, sliny, yellow soil. Its burrows are always found in plain tracts and never near hedges. In a burrow of 4" long and 2" broad, eggs were found in the last week of April and in the first week of May. In one burrow, only a single individual is able to live. The course of the burrow is usually detected by pushing a long, thin and pointed stick. On the mouth of the burrow a small mound of sand is usually found which indicates the presence of the animal in the burrow. *Uromastix* always sits with its tail towards the mouth of the burrow.

123. The chelonian type of genitalia of the Pond turtle, *Lissemys punctata* (Bonna-terre).

TRILOK MAJUPURIA, Shikohabad.

After studying in detail the types of copulatory organs in lizards and snakes (Majupuria 52-56) it is very interesting to note the diversity in form which exists in the type of copulatory organs between turtles and snakes and lizards. The chelonian type of genitalia is considered to be essential in interpreting the external genitalia of mammals. Detailed knowledge of the genitalia of Indian turtles is still lacking. The penis of *Lissemys* is a single median organ situated in the cloaca adjacent to the ventral wall and flattened dorsoventrally. It is represented by a pair of longitudinal folds and its surface is covered by mucosa of the wall of the cloaca. Free apex of the penis is found in *Lissemys*, however, it is not fairly separated from the wall of the cloaca. Outer layer of the penis is formed by the interwoven fibrous mass of tissue. The glans penis is exclusively formed by the cavernose tissue. There is a seminal groove between the two cavernous erectile tissues, which forms a closed channel during erection. It leads from the orifice of urogenital sinus to the terminal part of cavernous bodies. In females, clitoris is present as a thickening in the ventral cloacal wall. Erectile tissue is present in clitoris. The erection of the penis in *Lissemys* is due to rigidity of erectile bodies by vasomotar influence upon the vessels. The retraction is possible only by paired retractor penis, inserted to the ventral aspect of the penis running as fibrous band and attached to the ischium.

124. Sex-ratio in the toad, *Bufo melenostictus*.

BISWANATH MITRA and K. K. SEN, Chandernagore.

The paper deals with sex-ratio determination of the toad, *Bufo melanostictus* collected from Chandernagore area of West Bengal. Specimens have been collected during the rainy season in the years 1956, 1957 and 1958. The trend in the variation of sex-ratio in the months of July, August and September is shown and its nature discussed. The sex-ratio in each year shows a distinct minimum towards the first or second half of the month of August. The observations reveal the preponderance of females over the males.

125. Morphology of the Urinogenital Organs of a less common lizard of Bengal, *Gekko Gecko* (Linn.).

P. V. NAIR, Agartala.

An attempt has been made here to give an account of the morphology of the urinogenital organs of *Gekko gecko*.

The kidneys of *Gekko gecko* are a pair of roughly triangular and bilobed organs, uniting posteriorly by their tapering ends, and extending a little beyond and behind the vent. In the male, each ureter unites with the ductus deferens of its side and opens into the cloaca on the tip of a urinogenital papilla. The arterial and venous supplies to the system have also been discussed. The testes are a pair of whitish oval bodies, the right one being slightly larger than, and cranially placed to the left one. The vasa efferentia, ductus deferens and the hemipenis of the species have been described. The saccular paired ovaries of the female occupy almost the same relative position as the testes in the male. There are a pair of oviducts, comprising of an anterior ostium tubae, connected behind to a wide and thick-walled uterus, leading to the so-called 'vagina' which open into the cloaca separately from the ureters. The cloaca is divided into the coprodaeum, urodaeum and the proctodaeum.

126. Studies on some entomophagous mites and their possible use in biological control.

E. S. NARAYANAN and NANDINI S. KHOT, New Delhi.

It has been observed that the destruction of predatory insects and mites brought about a phenomenal increase in phytophagous mites. Predatory mites play a vital role in keeping down the population of phytophagous mites. The role of predatory and parasitic mites in the biological control of phytophagous mites and other insects need hardly be emphasised.

Very little is known in India on the taxonomy and biology of entomophagous mites. So, this aspect of study has received special attention during the present investigations.

The authors studied certain mites of the suborders Mesostigmata, Trombidiformes and Sarcoptiformes.

In the suborder Mesostigmata, the taxonomy of *Garmania* sp. nov. of the family Aceosejidae, a predator of the eggs and small nymphs of locust, and of the two *Amblyseius* sp. nov. of the family Phytosiidae feeding on the eriophyid mites, a pest of chillies, and on the eggs and quiscent stages of *Tetranychus equatorius* Meb., a pest of many economically important plants has been studied. *Amblyseius cucumerius* Oud. has been recorded predating on the eggs and quiescent stages of *Oligonychus mangiferus* Sapra., an important pest of mango.

127. Observations on the hypophyseal portal circulation in *Gegenophis carnosus*.

K. VIJAYAPRASANTHAN PILLAY, Trivandrum.

The hypophyseal portal circulation of the apodan hypophysis is described. The primary capillary plejus is supplied with blood by the first branch of the antero-cerebral artery. This branch, at a little distance anterior to the hypophysis breaks up into arterial twigs which enter the capillary plexus. A large number of vessels from this plexus proceed towards the anterior lobe where they break up into a network of capillaries. A long longitudinal vessel arising from the plexus also supplies the neural lobe. This vessel is probably similar to the communicating vessel described in anurans. Blood flows from the hypothalamus towards the hypophysis through the portal vessels. The blood is drained from the hypophysis by a pair of vessels attached to the hypophysis on either side, on the posterolateral aspect.

128. Taxonomic studies on the Bats of the Desert of Rajasthan.

ISHWAR PRAKASH, Jaipur.

The paper deals with the measurements of the body and skull of the bats and their distribution. Important variations in their colour and skull structure have been noted. Status of *Scotophilus kuhli* is discussed.

The Rajasthan Desert is geographically placed in such a position that towards West it passes into the deserts of the Palaearctic region and towards its east there are Arawallis followed by the wooded land. This desert, therefore, exhibits animals of both the regions—some typically desert forms and others significantly of humid type. This makes this study all the more important as well as interesting. Our survey of the bats elucidates their distribution. The following bats have been reported for the first time from the Desert of Rajasthan, India :—*Pteropus giganteus giganteus, Rhinopoma kinneari, Taphozous perforatus perforatus, Taphozous kachhensis kachhensis, Magaderma lyra lyra, Rhinolophus lepidus lepidus, Pipistrellus mimus glaucillus, Scotophilus heathi belangeri.*

129. Observations on certain insectivores and rodents in captivity.

ISWAR PRAKASH, Jaipur

The Hedgehogs (*Hemiechinus auritus collaris* Gray, and *Paraechinus micropus micropus* Blyth) and Gerbilles (*Tatera indica indica Hardwicke* and *Meriones hurrianae* Jerdon) were kept in the Laboratory in large cages, which had thick bottom of sand in which they dig their burrows. The hedgehogs were quite comfortable in captivity and so were the Indian gerbille, but the Desert Gerbille took about a week in adjusting to the new conditions. *Tatera* started feeding immediately. But the hedgehoges did not accept anything for the first ten days, a few preferred to die rather than to feed in captivity. A large variety of food materials were given to them and their choice for food was considered in four categories ; 1. most preferred, 2. preferred, 3. less preferred and 4. not taken.

HEDGEHOGS :—show less inclination for the Invertebrates, except the insects. Among them too, insects bellonging to Coleoptera and Orthoptera were preferred. Amphibians and lizards have good place in their menu. These could not be killed when alive but were eaten when given killed and ventrally incised. Though not always, snakes were also killed and eaten. Interesting duels between hedgehogs and snakes were observed.

GERBILLES :—The Indian gerbilles, *T. i. indica* has more varied diet than the Desert gerbilles, *M. hurrianae*. The latter preferred seeds while the former likes insects and flesh in captivity. Sometimes the *Meriones* feeds on insects, particularly the locusts. The *Meriones* prefer dry food to succulent food.

130. Mammalian Associations in the desert of Rajasthan.

ISHWAR PRAKASH, Jaipur.

The paper deals with the mammalian associations chiefly characterised by the type of soil and its vegetation. Thus three types of associations and 6 sub-associations are recognised in the Desert of Rajasthan :—

1. Sandy Association.—Sand Dunes, Sandy Hills, Sandy Plains (Sub-associations),
II. Rocky Association.—Rocky areas Lakes and Gardens, Caves and Tunnels (Subassociation),
III. Ruderal Association.

I. *Sandy Association.*—A major part of the desert region is covered by this type of Association. The three sub-associations are so much intermingled that it is rather difficult to limit them geographically. The abundant vegetation of these sub-associations is described. An exhaustive list of mammals is given under each ecological community. Important among them are : **Hedgehogs-Fox-Hare-Gerbilles-Gazelle,**

II. *Rocky Association.*—There are certain rocky areas near Jodhpur, Barmer and Jaisalmer. The rocks exhibited are : Volcanic—Malani Rhyolite and Sedimentary—Vindhyan Sandstone. The vegetation is typically rocky. The mammals found in this association are : Langur-Wolf-Jackal-Hyaena-Panther (only at Jodhpur)-Porcupine-Bats (are found in the caves and tunnels).

III. *Ruderal Association.*—This term is applied to the animal associations near human habitations, for instance—Rat-Mice-Squirrel-Shrew-Rhesus Monkey-Black Buck (protected by villagers)-Bats (found in deserted buildings).

131. On the presence of impulse initiating and conducting structures in the heart of Indian spiny tailed lizard, *Uromastix hardwickii* (Gray).

RAVI PRAKASH and SATISH CHANDRA MOWAR, Bhopal

The nature and disposition of the tissue that connects the various chambers of the heart of the Indian spiny tailed lizard *Uromastix hardwickii* (Gray) have been examined and described. The sinuatrial node similar to that of birds and mammals has been reported to be present at the dorsal and caudal portion of the constriction present in the dorsal wall of the sinus venous to accommodate the trachea. The histology of this node has been described to support the view that it can be regarded as the site of impulse initiation in the heart of this lizard. Another histologically specialized structure has been located at the caudal portion of the interatrial septum and is referred to as the atrioventricular bundle. This is regarded as homologous with the bundle of His found in birds and mammals.

132. The skull and the temporal region of *Mabuya dissimilis* (Hallowell).

JAGADISH PRASAD, Bhopal.

The skull of *Mabuya dissimiles* is streptostylic, parapsidan and metakinetic. The processus anterior tecti is osteocranic. The occipital condyle is basioccipital in origin. The postfrontal is fused with the postorbital and the parasphenoid with the interorbital septum. The frontoparietal shield is distinct as in salientia. A prominent bony process in the palate represents the pterygoprevomerine contact of Hattaria and thereby, it is a transitional stage between lizard and sphenodon. The temporal process of jugal does not allow orbito-temporal confluence. The members of the circumorbital series are complete. The splenial and angularis are distinct and dentition is pleurodont. The palatal part of the pterygoid is dentigerous.

133. The skull and the temporal region of *Lygosoma indicum indicum* (Gray).

JAGADISH PRASAD, Bhopal.

The skull is scincoid, parapsidan, streytostylic and metakinetic. The processus ascendens tecti is a bony stracture. A synovial joint exists at the basipterygo-pterygoidal connexion. The supranasal and lacrymal are prominent bones, hitherto unrecorded. The columella auris alludes the kinocraniate nature. The fusion of the postfrontal, postorbital and supratemporal comprises the complex bone which obliterates the supratemporal vacuity against Pearson's assumption. The reduction of the foramen retrotemporalis of Siebenrock is attributed to the excessive development of the pro-otic and supraoccipital. A solitary temporal arcade (jugal + squamosal) distinguishes into two channels by the hinder extension of the complex bone. A remnant quadratojugal represents the anterior part of the infratemporal arch. Contrary to Edgeworth the kinetic movements occur at three points in the paucity of the supraoccipito-parietal junction. The palate is edentulous and ligamentously connected. Lakjer's hemipterygoid is aborted. The pterygo-transpalatine projection is distinct. The angular and suprangular are separate entities. Dentition is pleurodont.

134. Occurrence of 'Otic Element' in the tree frog of Bhopal, *Hyla indicus.*

JAGADISH PRASAD, Bhopal.

Hyla indicus has a persistent otic element developed from the crista parotica. There is a complete supraotic-squamosal arcade in the temporal space. The squamosal angle ranges from 49 to 55° The otic element which extends from the squamosal to frontoparietal is homologous to the supratemporal. The relationship between bony temporal architecture and the depressor mandibulae has a bearing on the persistence of the otic element in *Hyla*. Contrary to the findings of Miner, Edgeworth and Watson the depressor mandibulae owes its origin to the otic element. The progressive modification of the depressor mandibulae is exhibited by the amphikinetic nature of the skull and also by the mobile jaw suspensorial apparatus. The independent existence of the supratemporal and supraotic in *Hyla* do not support Noble's views that Bufonidae and allied forms are ancestral to Hyla There is a distinct Bidder's organ revealing 'pflugerian hermophroditism'. The unique possession of the otic element and Bidder's organ in *Hyla* of Bhopal might probably justify the creation of a new species.

135. The skull and the temporal region of *Chamæleon zeylanicus* Laurenti.

JAGDISH PRASAD, Bhopal.

The skull of *Chamaeleon zeylanicus* presents features which are strikingly specialised. The skull is Alexander's helmet-like and has a single temporal arcade among three temporal vacuities The post temporal vacuity is being absorbed by a spacious supratemporal fossa. The post temporal arcade is not a separate entity. There is no concordance between the number of temporal fossae and the arcades which bound them and hence it is a modern representative of a modified parapsidan type. The prevomerine process of the palatine represents the transitional stage in the swift clemination of a well developed pterygo-prevomerine process of Rhynchocephalia. The maxillo-palatine shelf constitutes the secondary palate. The quadrate is streptostylic. The septomaxillary and the Jacobson's organ are present in the olfactory capsule. There is a remarkably long processus anterior tecti. The splenial is quite distinct in contrast to *Rhampholeon*. The supra-nasal-fontonallae and the external nasal openings are present.

Thus the skull of the Indian Chamaeleon exhibits interesting features which are, in fact, widely contradistinctive than those of other Chamaeleons described hitherto.

136. Induction by hypostome in Hydra : 'Competence' variable at different body levels.

S. SANYAL, Calcutta.

The inductive potency of isolated hypostome fragments of Hydra is well known. Results have been obtained to show that successful induction is the result of host-graft interaction. By varying the sites of implantation, it has been shown, that difference in 'competence' (of reaction to hypostome graft) exists along the axis of the body. A new secondary axis is induced only in the middle region. In the anterior levels the implant produces only hypostome with longer than usual tentacles, while in the posterior the graft remains as mere protruberance. The nature of gradation of 'competence' along the axis of the body is being studied to arrive at a definite conclusion of its qualitative and quantitative difference.

137. The regenerative potency of isolated fragments from the hypostome of Hydra.

S. SANYAL and S. MOOKERJEE, Calcutta

In the realm of determination, the hypostome region in Hydra is often cited as the dominant part in the determination of the morphogenetic pattern of this animal. The causal factors of the region remain largely unknown. Present experiments have been deviced to demarcate the regenerative potency of this region from other factors. Very small fragments, when isolated exclusively from the hypostome region, show interesting variation in their potency to regenerate. Starting from within a few hours (2-4 hours) after isolation, tentacles are completely recovered in 24 hours. But the isolates never recover any part of the stem or basal structure. The same fragment can reproduce tentacles several times successively after each cutting. In so doing the dimension of the fragment become gradually shortened and ultimately the regenerates become so small that further manipulation is rendered impossible.

The experiments point out that the region has only limited potency of regeneration against complete reconstitution exhibited by isolates of the stem material. Since the ectoderm in this region has been shown to have no interstitial cell, the importance of other cells in the process of regeneration in Hydra is augmented.

138. The blood vascular system and associated structures of *Scolopendra morsitans* Linn.

G S. SHUKLA, Gorakhpur.

The heart of *Scolopendra morsitans* has as many chambers as the trunk segments, each chamber having a pair of ostia at its posterior end. From each chamber arise a pair of lateral arteries From the first chamber arise three main arteries, of which the anterior one runs to the head, while the lateral ones form a ring round the gut. From the ring runs an anterior aorta and forms a ring round the nerve cord, at the base of the oesophageal ganglion. The body cavity is a hoemocoel and contains plasma with haemocytes. The heart lies in the pericardial sinus and is provided with alary muscles. Binucleate pericardial cells are also present. Heart pulsates in the forward direction. Fat body is found in the body cavity and appears like a chain of beads. These cells contain fat globules and their nucleus is very small.

139. The Respiratory System of *Scolopendra morsitans* Linn.

G. B. SHUKLA, Gorakhpur.

There are nine pairs of stigmata, the anterior pair is situated in the 3rd segment, each gives anteriorly ten tracheae which supply the head region, 1st and 2nd segments, posteriorly only three, two outer and two inner, tracheae. The second stigma lies in the 5th segment while the 3rd in the 8th segment and therefore the anterior tracheae of the 3rd pair are a little modified. Remaining stigmata are situated on the alternate segments. From a typical stigma arise two anterior dorsal, two posterior dorsal, one inner dorsal, one outer dorsal, one anterior ventral, one posterior ventral, one inner ventral and one outer ventral tracheae. There are a pair of ventral longitudinal tracheal trunks lying one on each side of the nerve cord. The posterior tracheae of the posterior most stigmata are also modified as they supply the 21st segment and the genito-anal region.

Each stigma has an outer chamber, the atrium in which lies the stigmal opening and the inner chamber, the tracheal sac from which arise the tracheae. The tracheal opening is Y- shaped and have bristles which form a kind of filter apparatus.

The tracheae branch and rebranch, their ultimate branches are known as tracheoles which enter the tissues. The contraction of the body of the animal expels air outside and when the muscles are relaxed air rushes in.

140. On the Rat Fauna of Delhi.

P. P. H. SUNDER SINGH and M. L. BHATIA, Delhi.

Seven varieties of rats consisting of the house rats and mice, the field and sewer rats, were collected from Delhi and surrounding villages.

The common house rats, *Rattus rattus* and the small house mouse, *Mus dubious* are prolific breeders and damage stored food material, furniture, clothes, books etc. in the houses. Two sub-species under the genus *Rattus* are: a blackish brown rat, *Rattus rattus rufescence,* and a greyish coloured one with white belly, *Rattus rattus rattus.*

The field rat, *Nesokia indica,* a serious pest of the gardens and lawns, occurs in great abundance.

The mole rat, popularly known as the 'black ghoose', *Bandicoota indica,* is a large sized rat which causes damage to the paddy store-houses and is most destructive to the crops. The "white ghoose", *Bandicoota indica* (albino) is recorded in small numbers from the slum areas of Delhi.

The Indian Gerbill or Antelope rat, *Gerbillus indicus,* another field rat occurs on the borders of cultivation and plains, damages the jawar, bajri and other crops.

The Indian Desert Gerbill, *Meriones hurriance,* is another field rat found in desert and semi-desert areas and destroys the jawar and bajri crops.

The brown rat, *Rattus norvegicus* occurs in the sewage system of Delhi.

141. Biology of *Aulacophora foveicollis* (Lucas).

M. K. MUKERJI and D. N. RAY CHAUDHURI, Calcutta.

This paper deals with the biology of *Aulacophora foveicollis* (Lucas) in W. Bengal. Its occurrence, hosts, feeding habit, behaviour, breeding habit, and migration have been studied.

The study reveals that the insect is available all the year round which is quite contradictory to the findings of other workers. The insect occurs only on Cucurbitaceous plants. It feeds on the leaves and sometimes on the sepals of the flower. It causes severe damage to the young plants but is not very harmful to the well developed ones. In copula the insects can be collected throughout the year and the period of copulation may vary from 8-14 hours. Other insects such as *A. frontalis, Epilachna sp.,* and certain hemipterous insects are also observed on different hosts in harmless association with *A. foveicollis* (Lucas).

142. Cytochemical studies of *Amoeba* sp.

G. P. DUTTA, Jullundur City.

The living amoebae show the cytoplasm differentiated into a clear hyaline ectoplasm produced into a broad pseudopodium and the granular endoplasm. The endoplasm reveals a nucleus, the mitochondria, lipid bodies, a contractile vacuole, accessory vacuoles food vacuoles etc.

Staining with Feulgen and Pyronin G/Methyl green, along with the trichloroacetic acid and ribonuclease controls, and Hg-BPB show the presence of Desoxyribonucleic acid (DNA), Ribonucleic acid (RNA) and proteins respectively, in the nucleus.

The mitochondria are composed of neutral fats (triglycerides), in addition to some complex lipoproteins and phospholipids. They are also rich in RNA. The lipid bodies appear as granules, composed of neutral fats (triglycerides), and complex lipoproteins.

The basiphil cytoplasm is rich in RNA, proteins and glycogen.

In the living amoeba the contractile vacuole is seen to arise by the coalescence of small accessory vacuoles, which slowly and slowly aggregate into 3 or 4 vacuoles and the latter finally unite to form a large contractile vacuole. A living amoeba which was ready to become encysted, was examined for 25 minutes and it was observed that the systole occurred at regular intervals of 5 minutes.

There is apparently no direct relation between the formation of the contractile vacuole and the lipid bodies or the so-called Golgi bodies. The lipid bodies which are granular, are not in any way transformed into the contractile vacuoles. The sudanophil lipid bodies and the mitochondria, however, aggregate round the growing vacuoles probably as a result of surface tension and in the fixed preparations it may give the impression of the wall of accessory vacuoles or the contractile vacuole having an osmiophil nature.

These amoebae develop at times a group of 5-15 finger-like projections at the posterior end which act as hold-fast and also help in locomotion and change of direction.

The defaecation takes place at the posterior end.

SECTION OF ANTHROPOLOGY AND ARCHAEOLOGY

President. -SHRI V. D. KRISHNASWAMI, M.A., Dip. Arch. (Cantab.).

Abstracts

I. PHYSICAL ANTHROPOLOGY

1. Physical characters of the Sunris of Assam.

BHUBAN M. DAS and USHA DEKA, Gauhati.

The present paper deals with the physical chracters of the Sunris, a liquor distilling and selling caste, who have taken to agriculture and as such may be considered as an agricultural people The data were collected from among 100 adult male individuals from an area lying west of Gauhati University at a distance of about 3 to 4 miles, in the month of July, 1958.

The Sunris generally possess dark, broad wavy hair with medium growth, brown skin colour, connected medium eye brows, dark brown eyes, homogeneous iris, speckled sclera, oblique medium eye slit, traces of medium fold, perceptible discontinuous supra-orbital ridges, straight horizontal nose with shallow medium depression, free medium earlobe Both alveolar and facial prognathism are absent. High percentage of mid-digital hair is observed in the IIIrd and IVth digits.

In somatometric characters, the Sunris are mainly between short and below medium in stature The mean stature is 162·62 cm. They are mesocephalic and mesorrhine (mean C I 77·62, mean N. I. 73·65) people but dolichocephalic and leptorrhine elements are also fairly strong among them. The hypsicephalic head occurs in majority Flat, medium and long faces are found in equal frequencies. The mean total facial index is 86·31.

2. Morphological Characters of Bengalee Skulls.

PAPIA BHATTACHARJEE, Calcutta.

The non-metric characters of a collection of 80 Bengalee skulls from Contai, Midnapore District belonging to the Department of Anthropology, University of Calcutta, have been studied. The characters described are : (a) ectocranial suture and metopic suture, (b) pterion, (c) wormion bones and Inca bones, (d) lower border of pyriform aperture and (e) parietal foramina.

3. Ape-line in Indian Aborigines.

A. R. BANERJEE, Calcutta.

The classical ape-line (Affenfurche or Vierfingerfurche) has been studied from the palm prints of Indian aboriginals comprising 413 Australoid males and 206 females represented by Kadars, Nayadis, Paniyans, Adiyans, Pahiras and Oraons; and 398 Mundari males and 137 females represented by Mundas, Santals, Birjias, Juangs and Sabaras. There is only one Mongoloid sample represented by 229 Abors of N.E.F.A. The Ape-line is present among the Australoids in 7·75 ± 1·31% and 2·91 ± 1·17% for the males and the females respectively whereas among the Mundaris the percentages for the same are $10 \cdot 55 \pm 1 \cdot 53$ and $4 \cdot 28 \pm 1 \cdot 48$ respectively for males and females. The difference between the above two groups is not statistically significant. No ethnic significance of ape-line could be proved.

4. Dermatoglyphics as Ethnic Criteria.

MANISH RANJAN CHAKRAVARTTI, Calcutta.

Dermatoglyphics have been utilised as a means of identification due to their permanency and extreme variability. As such they are valuable criteria for racial differences.

The present study comprises dermatoglyphic analysis of 485 Australoids, 490 Mundaris and 799 Mongoloids from India.

Pahiras, Paniyans, Adiyans, Oraons and Kadars may be classed under one ethnic group, which has been called Veddid or Australoid on the basis 60 : 40 (W : L) ratio.

The four groups Juangs, Sabaras, Santals and Mundas may be classed separately from the above Veddid group into another group on the basis of 40 : 60 (W : L) ratio. Because of their common linguistic affinities ,they have been classed as Mundari-speakers.

A nearly equal whorl-loop ratio (50 : 50) W - L appears to be the characteristic of the Mongoloid people.

5. Note on the Palmar Main Lines of the Parsi Community in India.

J. D. MAVALWALA, Saugar.

The Parsi community which migrated to India in the 7th century A.D. is a remnant of the complex population which comprised the empire of the Persian Achaemenids

The sample studied here consists of 1,124 Parsi palms constituted of 290 males and 272 females, formulated and analysed after Cummins and Midlo. The random sample was collected in the summer of 1956 from the urban Parsi communities of Lucknow and Bombay.

The total number of different formulae observed is 106, and the sample shows a Percentage of Dissimilarity of only 9·43% This is not high when compared to the other similarly analysed data from India, the United States and Japan.

The 11, 9, 7, formula occurs with maximum frequency in the entire series.

When considering the positions of the terminations of the four main lines D, C, B, and A it is seen that Line D ends most frequently in position 11 {58·47%}; Line C in position 9 {49·51%} and is frequently abortive {13·02%}; Line B in position 7 {45·59%} and 5 {43·14%}, and Line A in position 5 {41·36%}.

6. Dermatoglyphics of "Khonds" of Araku Valley (Visakhapatnam District, Andjara).

P. D. PRASADA RAO, Delhi.

The 'Khonds' occupy the northernmost part of Andhra and Southernmost part of Orissa. They inhabit a large area of Visakhapatnam District (namely Araku Valley and some of the districts of Orissa). The 'Khond' is a big tribe consisting of different groups like 'Konda Dora', 'Konda Kapu', Bagatha etc. They all speak a Dravidian language which is akin to Telugu and sometimes a mixture of Telugu Oriya in some part of Orissa.

From the analysis of the data it is clear that these people show much resemblence to the Orissan aboriginal people like Sabara, Munda etc. who are of Proto-Australoid ethnic stock. In these people there appears more number of loops (65·26%) than whors (29·08%) in which they are in conformity with Juanga, Sabaras and Mundas who also exhibit the same ratio. The pattern intensity Index of these people (12·95) which also shows resemblence with that of Khonds of Orissa (13·69) and Sabara 14·07 and Jaunga 14·06 in males and 13·53 in females. In Palmar prints also they show much similarity with the above people having mainline formula 7·5·5. . . in a majority of the cases; which is a characteristic of the Proto-Australoid ethnic stock. Anthropologists have classified the Tribal strata of the Scheduled areas into three main branches namely the Proto-Austroloid; Mongoloid and Negrito. The aboriginal groups of Andhra Desha mostly present the physiognomy of Proto-Australoid types. This view is held valid by observing these people who exhibit most of the characters.

7. Whorl on head hair of the Rajbansis and the Kacharis.

BHUBAN M. DAS, Gauhati.

The present paper deals with analysis of the data on the hair whorls at the junction of the two parieto-occipital sutures on the head, collected from among the Rajbansis and the Kacharis of South Goalpara, Assam, during the winter months of 1957-58. The data have also been compared with the existing data on some peoples of Assam as well as with some people's of North Western Himalayas.

From the analysis a close resemblance appears between the Rajbansis and the Kacharis in respect of this character of whorl on head-hair. As regards comparison with the peoples of North Western Himalayas, the position of the Rajbansis and the Kacharis is intermediate between the two groups, namely, the Mongoloid formed by the Bhotias and the Rajis, and the Caucasoid peoples—the Kanets, the Jaunsaris and the Tehri Gharwalis.

8. A Genetic Survey in the Rarhi Brahmin and the Muslim of West Bengal.

P. N. BHATTACHARJEE, Calcutta

The paper presents the results of a survey conducted on eight genetical characters, investigated among the Rārhi Brāhmin and the Muslim of West Bengal.

A_1-A_2-B-0 blood group gene frequencies are as follows:

	Rārhi Brāhmin (372)	Muslim (354)
A_1	0·165517	0·166308
A_2	0·013368	0·012109
B	0·216343	0·243104
O	0·604773	0·578479

The M gene frequencies of the Rārhi Brāhmin and the Muslim are 0·5945 and 0·6075 respectively.

The Rh chromosome frequencies with four sera, are as follows:

	Rārhi Brāhmin	Muslim
R_1	0·638471	0·713157
R_2	0·116873	0·097026
R	0·061434	0·043188
R_z	0·003752	0·013086
r	0·179471	0·133542

Secretor gene frequency for the Rārhi Brāhmin and for the Muslim is found to be 0·4615 and 0·4830 respectively.

No Sickling is detected in either of the communities.

P.T.C. Taster gene frequency for the Rārhi Brāhmin is ca. 0·41, and ca. 0·38 for the Muslim.

Percentage frequencies of Middle-phalangeal hair positive are 57·03 and 47·91 among the Rārhi Brāhmin and the Muslim respectively.

Percentage frequency of the Colour blindness (in Male) : Rārhi Brāhmin 6·91% and Muslim 5·61%.

9. A study on ABO and M. N. Blood Groups, and the ABH Secretion in saliva in the Nocte of North-East Frontier Agency.

P. N. BHATTACHARJEE, Calcutta.

The ABO, M N blood groups and the ABH secrete factor were investigated in the Nocte tribe of Tirap Frontier Division in the North-East Frontier Agency.

Three hundred and thirteen individuals were studied for the ABO blood groups. The gene frequencies were as follows : A=0·2184, B=0·1271, O=0·6545.

Two hundred and four persons were investigated for M N blood types. The M and the N gene frequencies were found to be 0·8015 and 0·1985 respectively.

One hundred and eighty-four saliva samples were tested for secretion of ABH substances. The secretor gene frequency was obtained as 0·6652.

10. RH Blood Types, Middle phalangial hair, and Colour-blindness in the Padmaraj (Pod) of West Bengal.

S. R. DAS and LALITA BOSE (GHOSH), Calcutta.

Continuing the genetic population studies among the Padmaraj (Pod) of West Bengal 250 individuals were put to Rh blood group tests using saline agglutinating anti-C, anti-D and anti-E, and albumin medium agglutinating anti-C sera. Chromosome frequencies calculated by the method outlined by Mourant are as follows :

R_1	R_2	R_0	R_z	R	r
0·587743	0·037992	0·099418	0·019671	0·186585	0·068590

About 4·8% of the tested population are Rh negative and 95·2% are -Rh positive.

In 168 males whose colour vision was tested with Ishihara Colour plates about 4·76% were found to be red-green blind. None of the females tested possessed this defect which is controlled by a X-linked recessive gene.

About 44·02% of the individuals examined (209 of both sexes) for occurrence of hair on the middle phalanges of both hands were found to be positive in respect of this trait and the rest negative.

11. A Note on the Chance as a Factor in Determining the Sex.

HIRENDRA K. RAKSHIT, Nagpur.

The note is based on the analysis of the published genealogies of hereditary deafmutism (Stevenson and Chees mean, 1955-6).

(1) At large, the sex composition of sibships is found to be in agreement with the binomial expectations. (2) Applying tests of independence, the hypothesis of Jastrzebski has been proved valid, i.e. the male-first-born sibships are likely to be predominated by male sibs and similarly, the female-first-born sibships are likely to be predominated by female sibs. (3) The all-male-sibship frequencies of the data under consideration are in close agreement with the Poisson expectations.

12. The blood groups A_1, A_2, B, O, M-N and the ABH secretion in saliva among the Padmaraj (Pod) of West Bengal.

LALITA BOSE (GHOSH), Calcutta.

The results of the investigation on blood groups and certain other genetic characters among the Padmaraj (Pod) of West Bengal are presented.

$A_1 - A_2 - B - O$ blood group gene frequencies were found to be as follows:

$P_1 = 0.089302$, $P_2 = 0.017608$, $q = 0.380351$, $r = 0{\cdot}512669$.

The secretor gene frequency came out as 48·68% and the non-secretor allele frequency as 51·32%.

The M and the N gene frequencies were found to be 62·6% and 37·4% respectively. The results of PTC taste threshold studies and Rh-blood types in the same population have been reported elsewhere.

13. The crystalline structure of bone mineral.

D. P. MUKHERJEE and S. R. DAS, Calcutta.

Animal bone of different geological ages, modern, Pleistocene, L. Pliocene and L. Triassic have been studied in the powder form by X-Ray diffraction in a Debye-Scherrer camera of 114·83 mm. diameter. Copper K-radiation through a nickel filter was used. The data have been analysed by the method suggested by Hesse (1948) and Stosick (1949). The size of the hexagonal unit crystal has been found to be given by $a_0 = 9{\cdot}40$ A.U. and $C_0 = 6{\cdot}88$ A.U., which agree well with the findings of Carlstrom reported in 1956.

The patterns of all the specimens mutually agree in a general way, but they undoubtedly exhibit certain graded differences between them, which may be attributed to gradual gain in crystal size with aging. The modern bone crystallites must be less than 10^{-5} cm. in size, but the L. Triassic bone crystallites must be in between 10^{-5} cm. and 10^{3} cm. across. The question of applicability of the noticed graded differences in 'dating' skeletal remains is under investigation.

14. A Genetic Survey among the Tentulia Bagdi and the Duley of West Bengal.

NARENDRA KUMAR, Calcutta.

During the year 1956-57, eight genetic characters were studied among the Tentulia Bagdi and the Duley of Chandernagore subdivision in the Hooghly district of West Bengal.

The gene frequencies for the $A_1A_2B.O.$ are as follows:

	Tentulia Bagdi (342)	Duley (241)
A_1	0·196396	0·195218
A_2	0·033016	0·017636
B	0·304492	0·311248
O	0·466096	0·475898

Frequency for the gene M is found to be 0·5675 and 0·6025 among the Tentulia Bagdi and the Duley respectively. With four sera the following Rh chromosome frequencies have been found for the communities :

	Tentulia Bagdi (342)	Duley (241)
R_1	0·741119	0·751883
R_2	0·116752	0·115933
R_0	0·000000	0·098999
R_z	0·013018	0·033185
r	0·121112	0·000000

The secretor gene frequency among the Tentulia Bagdi and the Duley are 0·5120 and ·4634 respectively. Sickling could not be found among 100 subjects of either community. P.T.C. taste thresholds which could only be studied among the Thentulia Bagdi yielded the taster gene frequency of 0·4425. Hairs studied on the middle phalanges are found to be present on 34·78 per cent Tentulia Bagdi and 41·98 per cent Duley individuals of both sexes. Among the males investigated 4·98 per cent Tentulia Bagdi and 5·94 per cent Duley are found to be colour blind.

15. M-N, Rh blood groups and A-B-H Secretion in the Rajputs of Farrukhabad, Mainpuri and Etah in U.P. and Dholpur in Rajasthan.

R. S. NEGI, Calcutta.

During early 1956, an Anthropological Survey was carried out amongst the Rajputs of Farrukhabad, Manipur and Etah districts in U.P. and Dholepur subdivision of Bharatpur districts in Rajasthan. The present paper discusses the results of M-N and Rh blood groups and A-B-H secretion in saliva. The gene frequency distribution for the above traits is given in the accompanying table.

16. A short note on the relation between stature and sitting height of some Bodo Tribes of Assam.

BHUBAN M. DAS, Gauhati.

In course of an anthropological investigation carried out among some Bodo Tribes of South Goalpara, Assam, data on physical characters including stature and sitting height were collected from among 100 male individuals of each of the following peoples : Hill Garo, Plains Garo, Pati Rabha, Rangdani Rabha, Maitori Rabha and Kachari. The present article deals only with analysis of the relation between stature and sitting height of these peoples.

II. SOCIAL ANTHROPOLOGY

17. A study of the living condition, education, employment, etc., of educated tribals living in Calcutta.

AMAL KUMAR DAS, Calcutta.

A study of the living conditions,, education, employment etc. of educated tribals residing in Calcutta was undertaken beginning from March, 1958 by interviewing them individually in their residences at hours, convenient to them. Up-to-date, 105 persons were interviewed, 74 Santals, 21 Mundas, 9 Oraons and 1 Ho. Of these, 82 live in messes and 23 with families. 58 are unmarried, 46 married and 1 widower. Besides the unmarried ones, 23 married persons also (with their families at home) live in messes. Of the 23 living with family in Calcutta 13 are nuclear type and 10 live in family groups.

In mess formation, people of the same District usually group together, as also persons of the same tribe, and further persons professing christianity have generally grouped together.

Of the 105 persons interviewed, 47 professed Christianity and rest 58 are non-Christians including 3 Hindus.

Of the 105, 45 are non-matrics, 32 matriculates, 7 studying I.A., 2 I.A. passed, 4 reading I.Com., 3 I.Sc., 4 reading B.A., 2 B.A. passed, 4. reading B.Com., 1 B.E., 1 M.A., B.L. Tribewise, Santals are much more advanced compared to Mundas and Oraons etc., and districtwise people of Midnapur and these of Bankura are definitely more advanced.

Of these persons, 1 is an Upper Division Clerk, 48 L.D.C., mostly in the postal department. Some work as postmen, sorters, packers etc. One is M.L.A., one is a Sub-Editor, one is an Asst. Engineer, 2 are Mail Guards and 2 are proof readers etc.

Some of these persons utilise their leisure-time attending night classes preparing themselves for higher education; others play indoor or outdoor games or have joined clubs like 'Adivasi Club' or 'Aboa Gaonta'.

18. The place of Anthropology in the education of Aboriginals in India.

M. N. BASU, Calcutta.

Education among the aboriginals is usually imparted in the family group in the nature of imitation and association; some get through initiation rites and subsequent discipline.

Education can be imparted in the educational institution only if education of both the children and the adolescent is centered round the main occupational work of life. The aboriginals are accustomed to this type of education so it should be the duty of the educationists to give proper facilities, by way of their culture-trait, in an institution where their education can be set up. So the type of education imparted to the aboriginals should not encourage them from being alienated from their native soil and environment, but should rather help them in improving their social and community life.

The present system of education of the aboriginals in India is futile and results in useless expenditure of money. A systematic planning is essential in which the linguistic dogmas or inter-provincial feelings would not find place. It is education which can change the ideas and attitude of the aboriginals and also their culture, so a thorough planning should be scrutinised by the anthropologist. A scheme of their educational policy should be directed to increase their solidarity. It should also equip these people to stand for the right, particularly in their rural economy. It cannot be denied that they will be absorbed into the culture of the advanced group' through education. So it is advisable that homoeopathic doses should be introduced instead of sudden thrust of highly allopathic.

In this paper the writer has put forth some suggestions for the educational planning of the aboriginals in India from the cases studied by the application of anthropological field-methods.

19. Note on the Socio-medical survey among the Toto.

B. K. ROY BURMAN, Calcutta.

The Toto are a small tribe on the border of West Bengal and Bhutan. According to the census of 1951 their number is 314. A Socio-medical survey among them was conducted by the author with assistance of Dr. Asish Dutta—a qualified medical man. As a result of the survey significant correlation was obtained in frequency of some of the diseases and some of the social habits, hygienic and food habits of the Toto.

20. Fertility Study of Ahir Women in a Delhi Village.

M. S. A. RAO and ASHISH BOSE, Delhi.

A good deal of confusion in the study of the fertility pattern of women in rural India is due to the reliance on the age at marriage. Since in most rural areas, marriage is only a ritual union without involving immediate consummation, it is not of functional significance for fertility studies. Much of the controversy regarding the effect of raising the age at marriage on fertility is unrealistic in the absence of adequate data regarding the age at nuptials. The object of this paper is to present a working model for fertility analysis based on four ages and six intervals, viz. (1) age at marriage, (2) age at menarche, (3) age at nuptials, (4) age at first birth, and intervals between (i) menarches and marriage, (ii) nuptials and marriage, (iii) first birth and marriage, (iv) nuptials and menarches, (v) first birth and menarche and (vi) first birth and nuptials. Our study of 119 over-maried Ahir women in Shamepur village on the basis of data collected by Mrs. Saroja Rao shows that the average age at marriage of women of the older cohort (present age : 30 years and over) is 11·8 years, while in the younger cohort (present age : below 30 years) it is 13·6 years, a figure still much below the statutory minimum (15 years). The age at nuptials of women in the younger cohort is 15·4 years compared to 14·7 years of those in the older cohort but this slight increase has not brought about any decrease in the age-specific fertility rates in earlier years. Because of the smallness of numbers, no generalisation can be made but the analysis does indicate that it is doubtful if raising the age of marriage of women in the rural social context will bring about a fall in fertility. It is hoped that surveys conducted on similar lines in various parts of India will throw more light on this controversial problem.

21. Early training and personality development.

U. GUHA, Calcutta.

An attempt has been made in this paper to show that in light of the information gathered from one of the preliterate tribes of India, namely the Bhil of Dhar State, Central India, it may be said that personality traits to a large extent are culturally determined and that the role of sex is assigned by the society. The social conditions are such among the Bhil that certain common personality traits are encouraged in both the sexes while others differ radically. Both are obedient to authority and thriftless. Both are familiar with the sexual act, child birth and death at an early age. Both divide the world into two divisions—'we' and 'they' i.e. the strangers. But while the Bhil man is bold and competitive, the Bhil woman is mild and co-operative. The Bhil man is noisy and aggressive, the Bhil woman is quiet and passive. There is an insistence on the Bhil boy to grow up quickly and acquire proficiency in special techniques. The Bhil girl has no puberty ceremony; nothing to mark her growing up. Her childhood gradually merges into aloleseence and thence into adulthood when she gracefully but quietly takes her place in society.

22. Periyapalayam Goddess.

M. S. GOPALAKRISHNAN, Madras.

The worship of a female deity in rural and urban regions is observed to this day in many places of South India. Periyapalayam in the Trivellore taluk of the Chingleput District is the abode of a reputed goddess in whose temple Telegu speaking Balija Naidus are priests for many generations. It has legends of origin as to how a piece of stone was discovered and how the Naidus came to be the priests there. This paper attempts to show the beliefs and practices of the many Hindus who come to this place in large numbers in the months of August-September. Till the end of 1950 animal sacrifices were given to this deity. Some of the interesting customs which Her devotees adopt to please Her are :

(i) Pural Thandam,
(ii) Adi Thandam,
(iii) Veppan Seali,
(iv) Mudi Koduthal,

the meaning of which all are explained in this paper. This is a very popular Hindu shrine not much influenced by Brahminic ways of worship.

23. Hunting festival of the tribals of the Ayodhya Hill.

SABITA RANJAN SARKAR, Calcutta.

Some changes from the traditional hunting festival of the tribals observed in the Ayodhya Hill have been noted in this paper.

A few generations ago, this festival was directly associated with socio-religious activities of participant tribals. At present it has been transformed into a fair with special tendency towards revelry. But to maintain its hunting tradition, women are still debarred from participating in it.

Educated tribals are not in favour of performing such festival and it appears that association of religious theme of the festival with Rama, the epic hero of Hindu neighbours, may be one of the reasons. Place of traditional hunt council that used to regulate social laws is now filled up by government officials and popular government administrative institutions. Finally, poor economic condition, reservation of forest, dearth of games have severely hit the festival. But on the other hand it need be noted that some people are now associating the festival with Santhal rebellion of mid-19th Century and it is not unlikely that by this association, the festival may attain a new politico-social significance leading to its revival in more vigorous form.

24. Bilateral Clan succession in East Africa.

U. R. EHRENFELS, Madras.

Bilateral Clan Succession is found among matrilineal Wa-Mwera,—the northernmost outpost of the Yao group in the Southern Province of Taganyika and also among the Luguru cluster of likewise matrilineal Bantu speakers in the central Eastern area of the country.

The two systems differ structurally; the first (Mwera) forming unbroken matri- *and* patri-lines for female and male descent groups respectively whilst the second (Luguru) system forms unbroken matrilines for female descent groups only,—not for male. The systems are explained and demonstrated on two sample genealogies. Some aspects of culture-geographical juxtaposition are considered.

25. A Preliminary Note on the Clans and their Segmentation among the Dhurwa of Marenga (Bastar).

KIDAR NATH THUSU, Calcutta.

This paper is based on field-work carried out during February and March 1958 in the Dhurwa village of Marenga (South Bastar). It offers a brief description of the structures and the functions of the various clans among the Dhurwas of the village mentioned above. It also deals with the lineal segmentations within the dominant Nag clan.

It was observed that the clans are patrilineal and patrilocal in character with some totemic affiliations. These clans do not, however, have any rigorous political or economic functions, and therefore, cannot be strictly labelled as corporate groups. On the other hand, the lineal segments in the Nag clan, such as the Pelash, Bodka, Dhur, Neutak and Kechak, do have common ritual functions.

Lastly, an interesting and anomalous case of accepted deviation from the principle of exogamy was noted with reference to a segment of Nag clan which is believed to have settled in village in recent times.

26. Cousin Marriage among the Riang.

BHABANANDA MUKHERJEE, Calcutta.

The Riang of Tripura practise both parallel and Cross-Cousin marriages along with clan exogamy and endogamy. The incidence of paternal parallel-cousin marriage is high. The paternal parallel cousins (male) are socially very important in the joint household of the Riang. In the kinship structure, the cousins are not distinguished. Comparison with other tribes and communities having family endogamy or cousin marriage, has been made in this paper to account for the possible origin of the parallel cousin marriage among the Riang.

27. 'Deogotia' Lineal Group among the Bhatra of Kinjoli (Bastar)—Its Structure and Functions.

J. S. TANDON, Calcutta.

This paper, based on field work done during October 1957, to March 1958, among the Bhatra of Konjoli, which is one of the six most thickly populated villages of northern part of Jagdalpur Tahsil of Bastar district, is mainly concerned with delineating the various functional ramifications of the patrilineal segment of a clan, known as *Deogotia.*

The members of the latter group are strictly exogamous and claim to be descendants of a common ancestor up to whom genealogical relations may or may not be traced. A dynamic interaction of the processes of "evolution" from the base-line of neuclear family and "devolution" from an unmanageably large size, appears to keep the size of this highly functional corporate group to an optimum limit.

Among the multiple items that contribute to the cohesiveness of Deogotia group, besides the features of a tradition of common ancestry and the principle of exogamy, may be mentioned the following: proximity in residence, common shrines, common offices of lineage head, pujari, sirha etc., common ceremonies such as Amus and Noakhani etc., obligatory observance of ritual pollution by the entire group, various reciprocal economic ties, and representation as a group in cases before the Panchayat.

28. A Socio-economic Study of the Markets of Pargannah Barabhum, Purulia.

BIMAN KUMAR DAS GUPTA, Calcutta.

The institution of weekly market was selected for anthropological investigation as a part of our general search for a unit larger in scope than the village community for the study of inter-ethnic relationships. Unlike an economist who would focus his attention primarily on such items as fluctuations of prices of various commodities in relative proportion of import and export with reference to a market, we are here concerned mainly with viewing the market as a characteristic network of inter-group relations and secondarily, as a characteristic inter-locking of spatial units forming the socio-economic hinterland of the market site. This particular paper presents data on four such weekly markets of slightly varying types, namely, those located at Burdwan, Balarampur, Barabazar and Bamandiha, keeping the first one as the model and the others as variants.

29. The Annual Cycle of Agricultural activities in a Dorla Village.

DURGADAS HAJRA, Calcutta.

This paper deals with a brief account of the annual cycle of agricultural activities of the Dorla, a tribe of South Bastar about whom there is practically no published ethnographic data.

The agricultural activities of the Dorla centre round the cultivation of a kind of millet locally known as 'janna'. They practise dry cultivation with ploughs and thus, in terms of technological efficiency, occupy an intermediate position in between the extensive wet cultivation practised in north Bastar by the Muria, Bhatra, Dhurwa, etc., and the shifting cultivation of the more primitive tribal groups such as the Hill Maria of Abujhmar.

The data were collected during February-March 1958 from the village of Injiram, situated on the bank of the Kolab river and lying 5½ miles north of Konta on the bus route connecting the latter town with Jagdalpur.

30. The Study of Social Integration in a little community.

GOURANGA CHATTOPADHYAY, Calcutta.

The paper in the beginning, describes the unifying factors in the social, religious, economic and political life of the inhabitants of a village in West Bengal during the pre-Independence Era, and then proceeds to show the changes that occurred in the wake of Independence due to external factors, and how, though the apparent unity of the villagers was disrupted, a unity in the broader sense is on the way to being achieved.

31. From Household Religious Ceremonies to Village Festivals : A study of changes in a Little Community.

GOURANGA CHATTOPADHYAY, Calcutta.

The paper begins with a description of the six community festivals and the temples, priests and families connected to these festivals of a village in West Bengal.

Next, the paper tries to show how the house-hold worship had to give way to community festivals due to economic reasons in the first instance. Once this was done, the villagers gradually changed their outlook towards these 'pujas' and came to look upon them as their own.

This new outlook again fostered a feeling of deprivation and humiliation in the minds of the majority of the villagers, who are the so-called lower castes. So, when they united to fight against economic oppressions, they also demanded equality in the religious life. Originally the change over from house-hold worships to community festivals was a very gradual process. But this last change came very quickly. There was not only the economic factor pushing from behind, but also the urban influence which lent a hand to the mighty heave that has so far resulted in the field of religion in achieving the control of the festivals by the majority of the villagers.

32. Community-structure in an Artisan Village of Pargannah Barabhum.

HEMENDRA NATH BANERJEE, Calcutta.

Baro Susni, an artisan-dominated village in Pargannah Barabhum was selected for detailed study, as a part of the general formation of indigenous state among the Bhumij tribe of Manbhum. An attempt was first of all made in this paper to examine how far this particular village is a self-sufficient unit and how far it is connected to and is dependent on a larger setting. Villagers of Baro Susni, have reasons to have a feeling of unity, as being the main possessors of lands within an area demarcated in terms of land-revenue unit and in possession of sacred-spots, village-council, some of the secular as well as sacred officials and major festivals in common. On the other hand, social relations of the villagers extend beyond the limits of the village in lineage-relationship, affinal or marriage ties, in procurement and supply of ritual services and daily labour etc. The paper also deals with various kinds of inter-ethnic relationship within the village, the hierarchy among the same groups in terms of ritual status, political power and sizes of economic holding (mainly in terms of land). Finally, a table has been given to indicate the extent to which various groups pursue their traditional calling.

33. Social Organisation of Dusserah Festival in Bastar.

SURAJIT SINHA, Calcutta.

The former feudatory state of Bastar, with its high concentration of "tribal" population (over 72% in 1931 census) is commonly regarded as one of the most isolated enclaves of "tribal" cultures in Central India. In the heart of the same area, at Jagadalpur, we witness a highly complex festival, the Dusserah, which used to be sponsored by the ruling family of this former feudatory state. The complexity of this festival, which brings together many of these "tribal" groups mentioned above, will be apparent when we note that its organisation involves 100 distinct specialised roles (managerial 13, ritual 51, and labour 36) played by approximately 4,214 persons, 16 ethnic groups (13 Hindu or Hinduised groups and 3 "tribal" groups) in exclusive roles, intensive participation by members of 14

Parganas covering 650 or more villages from an area of over 2,000 square miles and finally, the occurrence of ritual activities in 22 discrete sites.

Analysis of our data reveals that territorial affiliation (mainly villages in the context of Parganna) is by far the most important basis of organisation of the festival and that, even in the roles exclusively allocated to particular ethnic groups, specific territorial affiliation is an essential additional condition appended to the same allocations.

34. The social mobility of the Bhils of Banswara and their place in the regional social structure.

SURENDRA KUMAR NAVLAKHA, Calcutta.

The paper reviews the Bhil Society of Banswara in a regional social perspective. It is revealed that the Bhils had occupied a place as 'caste' for quite a length of time while their clear assignment to the 'Hindu caste' dates comparatively to recent times which also synchronizes with their noticeable ascent in the regional Hindu Caste Scheme.

The course of events and the causal sequence which led to the perpetration of these social changes have been examined and an emphasis has been given to the enquiry of certain fundamental issues and the underlying social mechanisms whereby the tribal social groups get admitted to the Hindu Caste Structure. An attempt has been made in continuation of the above theme to discern the basical internal character of the Hindu Caste Organisation and the principles around which it is structured which makes it appear so catholic in its attitudes towards admitting foreign social groups within its folds.

35. The Chirmars of Midnapur.

PRABODH KUMAR BHOWMICK, Calcutta.

The main subject of study in this paper are the "Chirmars", a fast disintegrating tribal people of Midnapur district in West Bengal, who are now concentrated in a compact area on the outskirts of Midnapur Town called "Chirmarsai", although these people had their habitats in the dense jungles widely spread over the district till a generation or two ago. Their main occupations were hunting and fowling and collection of forest produce. But with the march of time, the impact of ecological, political and economic conditions have brought them within the near fold of civilization. The Chirmars are only about 36 families now living in a compact mass at "Chirmarsai" within the jurisdiction of Midnapur Municipality. A few of them are also found at Bagnan in the Howrah District.

The word "Chirmar" has been derived from the Hindi words "Chiria" meaning an animal and "Mar" a killer The two together mean a hunter or trapper. These people have their peculiar social, religious and clan organisations, the special features of which have been discussed in this paper.

Economically and educationally backward, this tribe has now been striving hard to reestablish itself on a more firm economic footing. They have done away with most of their time-worn prejudices and have begun to seek the advantages of a civilized life which the local conditions and opportunities could afford them. Besides taking to any paying profession, they are making an effort to get the youngs of the tribe educated so that at the not too distant future, their community could be entirely freed from poverty and ignorance.

36. The rituals of the life cycle of the Lodhas.

PRABODH KUMAR BHOWMICK, Calcutta.

The Lodhas are a major tribal population inhabiting the hilly jungle tracts of West Midnapur in West Bengal. Prior to the revocation of the Criminal Tribes Act in 1952, they were known as a criminal tribe.

The main occupation of these people, due to the environmental limitations, is the collection of jungle products and selling these for money in the nearby markets to procure the various other items of daily necessities required to sustain the life. Lately, a small minority of the people have taken to agriculture.

Although tribal in nature, the Lodha Society has its own customs and conventions akin to those of the lower caste Hindus and as a race, they trace their origin in this section of the Hindus. Some of the peculiarities in the social framework and practices have been dealt with in this paper, mainly related to the life cycle of individuals as a part of the community.

As a people the Lodhas behave quite like civilized men in some of their social and religious ceremonies. They determine pregnancy of a woman from the date of the stoppage of the menstrual cycle as we or other people do. They enforce certain taboos on a pregnant woman in respect of her movements and food. Besides, these women have to wear charms and amulets to keep away the evil spirits from harming them till the child has been born safely.

After the child has been nurtured for five or seven months, according as it is a male or female one, a rice feeding ceremony is held. After child birth, they observe an unclean period for 21 days.

Marriage of the girls are generally performed before they attain puberty. As such, till maturity, such girls do not live with their husband. After a girl had her first menses, she could live with her husband, after a ceremony called 'Phul Dekhana' or showing of flowers. A second marriage is performed then.

The bride is selected by the groom's parents and a bride-price has to be offered after the final selection. The marriage is performed by the Kotal or the Deheri, or sometimes by a near relative. Sometimes the domestic skill of the bride is tested by asking her to carry heavy pitchers filled with water or sand to quite a long distance. There are other peculiar observances in connection with marriage as detailed in this paper.

When a man dies, he is either cremated or buried. In every case, the mourners observe an unclean period for 11 days and take a purificatory bath on the termination of the mourning period. They shave and pare off their nails and offer rice balls mixed with clipped hair and nails as food to the spirit of the dead. Holding of a communal feast terminates the mourning period.

These and other aspects of the Lodha society indicate that they are well on the road of approach to civilization than being enclosed by the original tribal culture.

III. ARCHAEOLOGY

37. A Note on agate industry at Cambay and its distribution in India.

B. K. CHATTERJEE and ARABINDA BASU, Calcutta.

This paper deals with the agate industry at Cambay, a coastal town of Bombay State. The industry has been in existence for about 2,000 years. The methods of manufacture have been discussed here and its distribution in India has also been shown.

Agate is variegated stone composed of nearly pure silica (silicon dioxide). Parallel bands of colour are often characteristic. Different varieties of agates occurs in different places in India and its characteristics have also been discussed.

In India, agates are mainly found in Bombay State, but mines exist also in Bengal, in the Rajmahal and Singhbhum Districts, in Hyderabad, in Jubbalpur and in Rudok district of Kashmir.

In form of microliths also, the agates are found chiefly in Banda district and Vindhyan Range, in Gujrat proper, in Bellary districts and in Brahmagiri.

Cambay, a traditional centre of agate industry in Bombay was visited for observing the method of its manufacture. The process includes successive stages of baking, rubbing, chipping, flaking, tempering, boring, and polishing.

Artificial agate industry is rapidly growing in Germany and other foreign countries. The introduction of artificial agates in Europe has seriously interfered with the industry in the recent years. This industry should be properly revived by adopting modern techniques and could be utilised as a source of earning foreign exchange.

38. The Persistence of Palaeolithic Types among the Stone Artifacts of Ceylon.

P. E. P. DERANIYAGALA, Ceylon

Ceylon was generally thought to possess an admixture of stone implements of various ages as surface deposits, and the types of artifacts thus obtained in association range from the 'Sohan' down to pitted, ground, and polished neolithic ones. Presently, excavation of stone age burials has brought to light the fact that this association of archaic as well as of advanced types occurs with stone age skeletons that are no older than the mesolithic. The possibility that many of the surface finds, both of Ceylon and of India, are the work of such a race is here put forward.

39. Kitchen Midden Industry of Andaman Islands.

P. C. DUTTA, Calcutta

During the winter months in 1952, some Kitchen Midden finds were unearthed from the Beehive Island (Andaman), and on the basis of surface exploration on the eastern coast of the island, a trial trench was laid accordingly, which has yielded the following :—

1. Stone-implements (*Microliths*),
2. Potsherds,
3. Shells of Molluscs (*Arca granosa* (Linn.) and *Cyrena sp.*),
4. Animal remains of Pig (Sus Andamansis), and
5. Human skeletal remains.

Kitchen Midden, as its name implies, consists mainly of masses of kitchen refuse that has been cast aside by man along with household and other materials. This paper presents the report of a study of this kitchen midden industry.

40. A Note on the deposits yielding Flake-scrapper Industries on Chert.

R. V. JOSHI, Bombay.

Since Dr. Sankalia's discovery, in the Pravara Basin (Bombay State) in the year 1956, of small Stone-Age tools comprising flake-point-scraper assemblage made on chert or other siliceous materials, several new sites from Central India, Bombay State and the northern Mysore State have yielded similar type of artifacts.

The tools from these distant areas are alike typologically as well as in the material used in their manufacture. The sediments associated with them, however, are varied, viz. gravel and cross-bedded sands (gravels II and III of the Pravara and the Godavari), brown sands and overlying fine gravel (Tamīnhal on the Malaprabha), and coarse silt (in the valleys of the Son and the Ken). But although there appears to be some dissimilarity in the various deposits, their physical characters such as size and stratification (absence of layers or cross-bedding) indicate their formation under drier climatic conditions. The associated tool industries i.e. Series II type of tools thus belong to the Dry Phase that followed the earlier Pluvial Cycle.

41. Pali, Pali, and Pali.

T. V. MAHALINGAM, Madras.

The author discusses in this paper the meaning and significance of the term *Pāli* used in three Brahmi inscriptions of the Tamil country. He thinks that the *Pāli* which was also known as *Pāli* originally meant a bed or sleeping place used by the Buddhist, Jaina and Āpīvika monks, and in course of time came to designate their residence and later still by extension it came to denote the hermitage of the monks and the temple attached to it. He suggests that *Pāli* came to be so called because it was exclusively the language of the monks who resided in the Pālis.

42. Recent explorations in Hoshangabad.

S. C. MALIK, Baroda.

In March, 1958 a short exploratory visit was made to Hoshangabad, Madhya Pradesh. The sole aim was to study the frequently referred to localities of De Terra and Paterson, to gain first hand knowledge specially, since the author had helped to carry out a river valley survey organized by the M.S., University of Baroda, on the Narmada at Maheshwar in 1957-58. The microlithic site of the Adamgarh hill was also explored. This visit was also to collect specially tools of the Middle Stone age and the microlithic industries, to make a typological study since this had not been done by De Terra and Patterson. They have neither illustrated nor described these industries.

Observation deviating from those of De Terra and Paterson, of these localities at Hoshangabad made it imperative to bring out this paper. Similar to the problem of the presence of Early Stone age tools in the lateritic pits of the Adamgarh hill is that of the presence of similar tools found in the black soil of the surrounding agricultural fields. Are these fields, a mile and a half south of Narmada, an old terrace?

In conclusion, it is emphasized that a study afresh is needed of sites worked by the pioneering workers because of not only in light of fresh surveys in other areas but simply to confirm and verify them since the foundations of Prehistory are based on these reference and type sites. The stress is also laid on fresh river valley surveys in different areas of the countries based on scientific lines.

43. Stone Age industries of the Satara district.

S. C. MALIK, Baroda.

This paper deals with the explorations carried out during the season of December, 1956 to June, 1957, in the Satara district, Bombay State. The area, of the thirteen sites discovered, covers Mahabelshwar, Panchgani, Satara town and Wai. The two latter sites are located on the banks of the Krishana river. The finds are mostly from the surface except those found in the river sections.

Judging from the location of the sites, the Microlithic people preferred hills—higher ground—overlooking fresh water pools. But they also inhabited remoter jungle areas which are far away from the transcontinental highway of communication and cultural dicusion.

The Early Stone age or the Lower Palaeolithic is conspicuously absent from this collection. But a rough outline regarding the Middle Stone age and the microlithic industries is discernible.

The tools of the Middle Stone age found in the bed of the Krishana river are similar to those found in areas of Bombay, Nevasa Maheshwar, etc. It seems probable that there was a typological development of this industry into the Non-geometric microlithic industry which in turn specialized into the Geometric industries. In the geographically backward areas of the country the Microlithic peoples seem to have survived very late into the historical period, the 16th to 17th century A.D. The evidence for this comes from the Mahabelshwar area where a beer bottle glass core was found. This evidence gives the new upper limit for the Microlithic industries whereas the finding of small flake-blades and a microlithic core in the Upper gravel of the section on the Krishna river gives the lower limits. This long spread of the microlithic industries in time is confirmed by other sites in India and abroad.

44. Lithic tool industries of the Chalcolithic cultures in West India.

S. R. RAO, Baroda.

The microliths of the Chalcolithic phase in India differ considerably in function technique and typology from the microliths of the mesolithic phase. The excavation by the author at Rangpur, a Chalcolithic site in Saurashtra has brought to light microliths with geometric forms unassociated with pottery in pre-Harappan levels. The Harappans used chert blades without retouch. In the transition phase of the Harappa culture and later on assymetrical flakes of jasper and agate were worked into scrapers. More than 40 chalcolithic sites have been located as a result of the survey of Kutch, Saurashtra and Gujarat during the year 1953 to 1957 and some of them are excavated. In the post-Harappa period parallel-sided blades of chalcedony with crested ridge or crudely worked scrapers of jasper and agate were used depending on the nature of the raw material available. Microliths with geometric forms unassociated with pottery were found at several sites. Lunates and flake-blades were the chief tool types. Parallel-sided blades with crested ridge found at Gop in Saurashtra and Jaora in Chitogarh Distt. are also unassociated with pottery, but absence of pottery does not mean an early age. The microlithic sites are classified as follows :—

1. Sites with geometric microliths unassociated with pottery.
2. Sites with parallel-sided blades and cores with crested ridge but unassociated with pottery.
3. Sites with parallel-sided blades crested ridge and scrapers associated with pottery.
4. Sites with blades and scrapers in definite chalcolithic context.

45. The shouldered celt in Eastern India.

DHARANI SEN and GAUTAMSANKAR RAY, Calcutta.

The typology, distribution and chronology of the so-called shouldered celt have been discussed with special reference to Eastern India. The probable functions of the different types and their anthropological significance have also been discussed with reference to a wider cultural setting in SE Asia. A classification with nomenclature based on typology and functions has been suggested.

46. Quarternary pebble, core and flake cultures of India—An Appraisal.

K. V. SOUNDARA RAJAN, Baroda.

In this paper, a bird's eye-view is taken of the broad technological cultural criteria involved in the Old Stone Age tool industries of India in the light of recent research and of the better-worked out parallel culture data from other parts of the Old World. In particular, a few outstanding issues such as the assessment of Sohan cultural influence and Middle Stone Age developments in India, have been given scrutiny. A comparative chart of Stone Age cultures for the Afro-Asian regions is also presented, based on published researches

SECTION OF MEDICAL AND VETERINARY SCIENCES

President :—SHRI P. G. PANDE, M.SC., M.R.C.V.S.

Abstracts

MEDICAL SCIENCES

1. A note on the electrophoretic pattern of *Serum Proteins* in acute haemolytic anaemia in rats.

MRS. V. V. CHIPLUNKAR and M. SIRSI, Bangalore.

Phenylhydrazine in 12 mg./kg. dose induces severe haemolytic anaemia associated with pathological involvement of liver, spleen and other organs, simulating those observed in acute experimental malaria. Since the etiological factors and the sequence of events involved in the haemolysis are different, a study of biochemical changes in this condition has been carried out and compared with those observed in other toxic and haemolytic states.

Electrophoretic studies on rat serum proteins in phenyl-hydrazine-induced haemolytic anaemia of rats indicate practically no alteration in total serum protein but appreciable increase in γ globulin and a slight decrease in albumin. No marked changes in α_1 and α_2 and β globulins, and no new components have been observed Mobilities do not show any change in this pathological state.

Since no infective or antigenic stimulation is involved, no explanation can be offered for the large increase in the γ globulin fraction observed in the haemolytic anaemia.

2. Effect of chorionic gonadotrophic hormone on spayed mice and rats.

N. K. ROY, S. K. GANGULI and S. R GHOSH, Calcutta

Observation on the result of castration in mammals indicate that wherever specific structures are associated with the sex, castration affects their growth. In young rats and mice, after ovariectomy, uterus and vagina become infantile, mammae remain undeveloped and sex-cycle does not occur. Zondek and Aschhim found that urine of pregnant women is a very rich source of material which induces estrus in spayed rats and mice. A series of experiments with alcoholic precipitate of early-pregnancy urine when administered both per mouth and subcutaneously to our inbred alkino rats and mice showed that urinary principle thus separated cannot affect estrus even at a very high dose level. The same spayed mice, however, respond quickly to estrogen at a much lower dosage. It is thus apparent that estrogenous material present in pregnancy urine is not available in free state to cause estrus. It has been observed that even after initial priming with estrogen, the urinary fraction cannot produce any result. But significant development was, however, noticed in these latter group of animals as regards body weight and deposition of fat in the abdomen, which was particularly absent in un-primed animals. The sex-characteristic however remained infantile in both the groups.

3. Effect of benzene and bromobenzene administration on glucuronide excretion in rabbits and cats.

D. ROY CHOWDHURY and D. P. SADHU, Calcutta.

Rabbits excrete quantitatively more glucuronides than cats in normal and experimental conditions. Excretion of ester, total and ether glucuronides in rabbits and cats per day per animal is 18-22 mg., 44-46 mg., 34-40 mg. and 14-19 mg., 28-37 mg., 7-14 mg. respectively. After administration of benzene and bromobenzene there is about 80-90% increase in the excretion glucuronides in Rabbits while the percentage increase in the excretion of total glucuronides in cats is between 60-70%. The liver glycogen content is rabbits after administration of these compounds show sign of depletion. The normal liver glycogen content varies from 4·2-4·8 per cent while after administration of benzene it ranged from 2 4-3 0 per cent.

The nitrogen excretion in rabbits and cats following such administration did not change.

The results indicate a difference in the capacity to form glucuronides in these two species of animals

4. *In vitro* studies on the anthelminitic activity of Carica papaya (Linn) seeds.

M. K. KRISHNAKUMARI and S. K. MAJUMDER, Mysore

In vitro studies on *Toxascaris transfuga* and *Ascaris sp.* with *Carica papaya* seed in Ringer-Lock medium demonstrated the vermicidal activities of the seed. The activity of one gram of papaya seed (Honey dew variety) was found to be equivalent to 250 mg. of piperazine citrate

The ascaricidal activity was more in freshly powdered seed than one powdered and stored under room temperature. The loss of potency in stored powder of the seed was significant within one week of storage Preliminary feeding trials with albino rats have indicated that feeding even at a level of 1300 mg./kg. body wt. (active ingredient present in 5·2 gms. of fresh whole seed) for three weeks had no adverse effect on growth.

5. Tracer studies on Vitamin B_{12} absorption in normal individuals and patients with tropical nutritional anaemia.

S. KAUL, DAS GUPTA, N. R. KRISHNAN and D. N. S. RAO, Poona.

Considerable controversy exists about the aetiological factors responsible for the casuation of tropical nutritional megaloblastic anaemia. One of the basic problems which needs elucidation is the absorption of vitamin B_{12}.

We have used urinary excretion following an oral dose of radioactive Cobalt tagged vitamin B_{12} in accordance with modified Schilling technique, for the purpose. Ten normal males were studied and their total urinary excretion, in terms of the percentage of the oral dose, was determined.

Of the fourteen patients diagnosed as suffering from nutritional megaloblastic anaemia, seven showed a low excretion which was not significantly altered by the simultaneous administration of 50 mg. of a purified intrinsic factor preparation. This finding is contrary to the present theoretical explanation for such cases of "nutritional" anaemia. Further study to investigate the problem is in progress.

6. The nature of antagonism to hexamethonium bromide (HMB) at the autonomic ganglia.

J. K. MOHANTY, Cuttack, (Orissa).

The nature of antagonism to hexamethonium by its metabolites at the autonomic ganglia was studied by using vascularly isolated perfused superior cervical ganglion-nictitating-membrane preparation in cats (Mohanty, 1955). The perfusing medium was a blood substitute as reported before (Mohanty, 1957). Plasma of patients under HMB treatment presumably containing the metabolite of the drug and HMB solution treated *in vitro* with the liver principle isolated by the author (Mohanty, 1957) was used in the test. The results of this study indicate that the degradation product of HMB antagonises the effect of the parent substance at the autonomic ganglion. The nature of antagonism seems to be reversible dynamic equilibrium type.

The concentration of degradation product of HMB in the blood of patients under treatment with this drug increases gradually and that the maximum is reached in several weeks with the continuance of the treatment. After the drug has been discontinued there is a progressive reduction in the concentration of HMB metabolite in the plasma of treated patients.

7. Pharmacological studies of some quinolyl-thiazole derivatives.

J. K. MOHANTY, B. N. DAS and B. DAS, Cuttack.

Twenty compounds which are quinoline-thiazole derivatives were tested for antihistaminic and spasmolytic activities. The potency of the compounds in preventing contraction of isolated guinea-pig ileum produced by histamine, and blocking the histamine-induced hypotension in dogs were studied. Spasmolytic property was also studied on isolated tissues by using acetylcholine as the spasmogen. Out of the compounds studied only three exhibited antihistaminic activity. Of these two are very feeble histamine-antagonists. But the remaining one M51-BB (Code number) seems to possess strong antihistamine action. On isolated guinea-pig ileum it produced 50% blockade of effect of a standard dose of histamine in a concentration of 1 in 50,00,000. Studies of relative potency shows that this compound as an antihistaminic is four times as strong as Antistine. It also exhibited good antiacetylcholine activity. Nine other compounds excluding M51-BB exhibited feeble antispasmodic action, which probably is not of much consequence. It is of interest to note that the compound M51-BB which seems to be a powerful antihistaminic does not have the essential groupings believed to be necessary for antihistaminic action.

8. Effectiveness of some antimalarial drugs in ectopic ventricular tachycardia resulting from acute myocardial infarction and ventricular fibrillation elicited by focal cooling in dogs.

R. B. ARORA and P. L. SHARMA, New Delhi.

Antimalarial drugs as a group have been investigated in ventricular tachycardia resulting from acute myocardial infarction in 48 dogs. Mepacrine, chloroquin, plaquenil, primaquin and isopentaquin were more effective than quinidine in combating this arrhythmia in unanesthetized coronary dog. Camoquin did not produce any beneficial effect. Paludrine produced only a weak effect. Further the protective action of mepacrine, chloroquin and camoquin in ventricular fibrillation elicited by focal cooling was also investigated in 24 dogs. Chloroquin and mepacrine were stronger than quinidine in their protective action against thiis arrhythmia. Mepacrine was the most effective drug in this respect. Camoquin however, afforded a partial protective action, the onset of fibrillation was delayed but not prevented.

9. Studies on volatile iil content and other extractives of some common Indian spices.

PROMODE K. SANYAL and B. K. GHOSH, Calcutta.

Spices or their essential oils are useful for imparting a pleasant taste to otherwise disagreable medicines or food. When taken internally some are beneficial in cases of flatulence and colic. They are also helpful in cases of gastritis and dyspepsia. The essential oil content and other extractives of six very commonly used spices were studied and the following results were obtained. The physical properties of these oils were studied and they were found to be within limits of already determined factors. Suitable methods of obtaining maximum amount of essential oil in the laboratory scale were also studied for each of the spices.

Ordinary steam distillation process to obtain the essential oil in cases of coriander, cardamom, Bengal cardamom and nigella seeds give much less amount of oil. So, the ordinary method was modified. In cases of fresh garlic and onion, however, this process could not be used—as they contain fractions which boil at on much lower temperature. For such spices ether extraction process was favoured to the steam distillation.

The average yield of the essential oils of the ordinary bazar materials are given below :--

Cardamom	5·00%
Bengal cardamom	1·15%
Coriander	0·19%
Nigella seeds	0·68%
Garlic fresh	0·07%
Onion fresh	0·03%

The water soluble extractives, ether soluble extractives and alcohol soluble extractives were determined for each of the spices. In all cases B.P. methods were followed. Among the different extractives it was found that the water soluble portions were of the highest percentage in all cases excepting the seeds of *Nigella sativa* and onion. In the case of garlic the water soluble extractive was 21% whereas the ether soluble extracrive was only 0·5%. Onion has the alcohol soluble extractive as 14% whereas teh water soluble extractive 12% and the ether soluble extractives as 1·5%. Bengal cardamom (Bara Alachi) has more water soluble and alcohol soluble extractives than cardamom, whereas their ether soluble extractives are the same. Nigella (Kalajira) seeds gave the highest percentage of ether soluble extractive as 37% and Coriander gave 14·2%. The alcohol soluble extractive of both Nigella seeds and Coriander were found to 6·3% and 8·2% respectively.

10. Antibacterial properties of some Indian spices.

PROMODE K. SANYAL and B. K. GHOSH, Calcutta.

The fact, that spices have some antiseptic properties, is a popular belief and in the second quarter of this century some people had tried to find out the antiseptic properties of some of the spices. The antiseptic properties of cloves and thyme have a place in mouth washes to check the spread of pathogenic bacteria. It is now accepted that others might have antiseptic properties.

In the present investigation antibacterial activity of the six very commonly used spices were taken up. The essential oil of these spices were extracted by means of a volatile oil determination apparatus and the following general method was adopted to determine the antibacterial properties of all the oils.

Small quantities of the essential oil were mixed with such an amount of propylene glycol that has no antibacterial effect when taken alone and were taken in sealed ampoules and sterilised. These were then transferred asceptically in separate test tubes of prepared nutrient broth, previously sterilised. Each of these was inoculated with 0·1 c.c. of a 18 hour culture (in nutrient broth) of *B. typhosus* and incubated at 37°C. for 24 hours. After this period, from each of these test tubes a new test tube was inoculated respectively with a loopful of culture and the new test subcultures were incubated for 48 hours and observed for growth. The following was the result :—

Oil obtained from :	Observation.
Cardamom	no growth.
Bengal cardamom (Bara Alachi)	no growth.
Nigella sativa Seed (Kala Jira)	no growth.
Garlic	no growth.
Onion	no growth.
Coriander	no growth.
The control tubes without any essential oil but only with propylene glycol	growth.

The experiment showed that the above essential oils possess antibacterial properties.

11. Effects of long continued oral administration of "Tolbutamide" on the pancreatic insulin potency and pancreatic amylase content of normal guinea pigs.

H. D. BRAHMACHARI and MAHENDRA KUMAR, Pilani.

"Tolbutamide" (1-butyl-3-p-tolylsulphonylurea) has now been well established as a suitable orally effective hypoglycemic agent for diabetic patients with the *"maturity onset"* type of diabetes mellitus. The precise mechanism of its action is as yet unknown. The present report indicates results obtained in one of a series of animal experiments performed to elucidate its mechanism of action.

Groups of normal healthy guinea pigs were administered "Tolbutamide Powder" (Albert David & Co.) orally in a daily dose of 100 mg./kg. The pancreatic amylase content of these animals and the biological potency of their pancreatic insulin were determined at regular intervals by using standard methods. It was observed that both the amylase content as well as the biological potency of pancreatic insulin of the experimental animals gradually increased with an increase in the period of administration of the drug as compared to normal controls. The experimental animals all maintained good health during the period of tolbutamide administration. It was also observed that the experimental animals after prolonged administration of tolbutamide showed increased resistance to anesthesia by a mixture of anesthetic ether and absolute alcohol (3 :1) as compared to the normal controls. Partially depancreatised (4/5th pancreas removed) animals of the experimental group showed an overall better survival than the normal controls, under exactly similar conditions.

12. Comparative effects of 'Tolbutamide' and Insulin on the oral glucose tolerance curves in rabbits.

H. D. BRAHMACHARI and MAHENDRA KUMAR, Pilani.

Dulin and Jonston and others maintain that the hypoglycemic action of 'Tolbutamide' is brought about by the stimulation of the secretion of insulin or some other hypoglycemic factor by the B-cells of islets in pancreas. The present report records the comparative effects of oral Tolbutamide and insulin injections (i.p.) on the oral glucose tolerance curves in normal fasting rabbits.

One group of rabbits (of same weight, and about similar B.S. level) were given Tolbutamide (100 mg./kg.) followed by glucose (1 gm./kg.) after one hour and the glucose tolerance determined while similar another group of rabbits received intraperitoneal injections of 2 units crystalline insulin per animal, followed by the same dose of glucose after 15 minutes of injection and the glucose tolerance was determined as usual.

On comparison of these glucose tolerance values obtained in the two groups with the normal glucose tolerance values, the following observations were made :—

(1) In case of 'Tolbutamide' there is a transitory initial hypoglycemia followed by hyperglycemia with a peak in B.S. level reached in two hours after glucose feeding. This is followed by a profound hypoglycemia.

(2) In case of insulin, there is a profound hypoglycemia with the lowest blood sugar value attained within one hour of glucose feeding (1¼ hr. after insulin injection) which is maintained for one hour. This is followed by rise of B.S. level reaching the fasting value in three hours from the start.

13. Effect of 'PABA' on the hypoglycemic action of *"Tolbutamide"*

H. D. BRAHMACHARI and MAHENDRA KUMAR, Pilani.

PABA (p-Amino-benzoic acid) is a well-known agent which antagonises the antibacterial action of the sulphonamides in the body. 'Tolbutamide', the orally effective sulphonamide in diabetes mellitus has been reported to be completely ineffective in its hypoglycemic action if the sulphonyl group is replaced in the molecule. It was thoght worthwhile, therefore, to study the effects of PABA on the hypoglycemic action of 'Tolbutamide' in laboratory animals.

Groups of normal rabbits were given PABA under different conditions, and the hypoglycemic action of 'Tolbutamide' (100 mg./kg.) was studied in each case. The following results were obtained :—

(1) PABA (oral, 100 mg./kg.), exerts a temporary, but definite hyperglycemic action when given alone.

(2) It appears to delay the onset and also prolong the hypoglycemic action of 'Tolbutamide'.

(3) It also tends to shorten the hypoglycemic phase of insulin (cryst.) injection, when administered orally one hour before the insulin injection (i.p.).

14. A preliminary study of the action of an intravenous antihistaminic drug in cases of cholera.

HEMENDRA NATH CHATTERJEE, Calcutta.

The therapeutic effects of the antihistaminic drug Chlorophenpyrimidine-maleate in 31 clinically advanced cases of cholera (12 of whom were culture-positive) have been studied. The drug was given intravenously in 10 mg. dose mixed with saline in the first transfusion bottle. All the cases were pulseless on admission.

The main observed results were :—

1. The drug has been found to have no effect on choleraic diarrhoea in any improvement on the frequency or the amount and nature of the evacuations in these advanced cases.

   Whether it has any value in the early cases or as a preventive of the onset of explosive bowel symptoms would have to be studied further.
2. The most remarkable effect of this intravenous antihistamine was prevention and control of hyperpyrexial reaction which is a dreaded phenomenon on cholera cases especially after the transfusion of salines.
3. There was a definite sense of well being in the treated patients, but it could have been due, at least partially, to the action of the drug in controlling fever.
4. Except a feeling of dizziness in 2 cases, which was very temporary, no other untoward effect was seen in 31 cases treated with this drug.

15. Lens changes in methionine deficiency induced by an anti-metabolite.

KALYAN BAGCHI, Calcutta.

Sulphydryl groups play a very important part in the metabolism of the lens. In all forms of cataract and precataractous conditions, its concentration either completely disappears or is reduced to a great extent. It has recently been shown that dietary protein and especially methionine maintain the concentration of this group in the lens.

In the present investigation, albino rats were weaned on to a low protein diet at 4 per cent level. Methionine sulphoximine, an anti-metabolite of methionine was administered by intra-peritoneal route in the dose of 20 mgm. per kg. body weight. Ten such injections were given on alternate days.

The animals showed mature cataract in 6 weeks time. Biochemical examination revealed complete absence of total sulphydryl and its fractions. Histological examination showed complete destruction of lens architecture.

Methionine supplementation, when started early reversed these changes.

16. Pancreatic insufficiency test using very low doses of RIHSA.

FAZLE HOSAIN and SUBHAS R. BASU, Calcutta.

Pancreatic insufficiency test, so far its proteolytic activity is concerned, has been carried out with very low doses of radio-iodinated human serum albumin An anticoincidence gas flow counter has been used and a dose of 0·04 μc/kg. of body weight has been found sufficient for the test. After an oral dose with gelatine in an empty stomach, blood is collected at different intervals for the first few hours and the percentage of the radio-iodine absorbed by the gastro-intestinal tract, as found in plasma, is calculated. Plasma volume is obtained by T 1824 method. It has been found that only the 2nd hr. plasma sample can represent quite satisfactorily the pancreatic condition of the normals and the patients.

17. Studies on cerebrospinal fluid of Indian infants and children.

A. C. MAJUMDAR, and R. P. MISRA, Calcutta.

Observations have been made on the analysis of cerebrospinal fluid in one hundred cases of infants and children admitted in the indoor of the Institute of Child Health, Calcutta during its first year. Cerebrospinal fluid undergoes profound changes in different pathological conditions even in various neurological symptoms. With an idea ot throw some light as well as collect some data for record which might help others in future the present paper is communicated.

Analysis of the data of C.S.F. on protein, sugar and chloride based on chemical analysis is made and an establishment of some relationships with clinical and pathological conditions have been attempted. Most of the cases belonged to lower socio-economic status. Number of males predominated over the females in all the age groups. Two peaks of incidence were observed in both the sexes, one at the age of 9-12 months in case of males and 3-9 for the females while the second peak was at 2-4 years for both the sexes. Pattern of the incidence of morbidity in both sexes were almost the same in other age groups but there was a trend of fall starting from 2-12 years with maximum peak at 2-4 years of age groups. Majority of the cases presented more than one symptoms and on analysis the most frequent symptoms complained was fever (51%). Next in order came convulsions (24%) and vomiting (20%). Analysing on diagnostic aspect, tubercular meningitis claimed the heaviest toll (22%). Next in order was encephalitis (13%), cerebral palsy (11%), etc. Incidence of polio was significant (6%). In 19 out of 22 cases of tuberculous meningitis the protein content was found to be above 60 mg.% (range 70-400 mg.%), sugar below 60 mg.% (range 9-58 mg.%). Chloride content was below 600 mg.% (range 325-567 mg.%) in 14 out of 22 cases of it. Confusing pictures were presented by cases of encephalitis, poliomyelitis, cerebral palsy, etc. Malnutrition cases presented relatively constant and significant figures. The highest protein value was obtained in cases of purulent meningitis (700 mg.%) and the lowest figure in the case of encephalitis (17 mg.%). Highest sugar value (143 mg.%) was obtained in cerebral agenesia and lowest value (9 mg.%) in tubercular meningitis. Highest value for chloride (920 mg.%) was found in the case of polio and lowest value (320 mg.%) in purulent meningitis.

Full dependence on the laboratory findings for diagnostic purposes has been discouraged. Value of methodical examination, investigation with controls and proper corroboration with the clinical findings have been stressed.

18. Role of Plasma cholesterol in angina of effort.

DR. D. P. BASU and K. B. BAKSHI, Calcutta.

(a) 20 patients were studied in this group. The total cholesterol mean was 284·7 mg.%; free cholesterol mean was 61·4; $\frac{F}{T} \times 100$ was 26.

(b) These patients showed a much greater tendency to hypercholesterolaemia; of the 20 patients 19 showed plasma cholesterol greater than normal mean.

(c) Free cholesterol concentration in the plasma showed a similar general and indeed propoftional increase above the normal mean, the value of $\frac{F}{T} \times 100$ remaining unchanged.

(d) The age effect found in acute myocardial infarction did not exist in this group of patients.

(e) The tendency to hypercholesterolaemia is roughly related to the time elapsed since the first attack of pain.

19. New method of estimation of Tolbutamide.

P. M. PARIKH and S. P. MUKHERJI, Bombay.

A new method for estimation of tolbutamide is described.

Tolbutamide is converted into its neutral sodium salt with aid of sodium hydroxide and excess of sodium hydroxide is neutralised with acetic acid. The sodium salt thus formed in a neutral media is then reacted with silver nitrate to form an insoluble mono-silver salt. Precipitate filtered, washed and excess of silver nitrate in filtrate is titrated with ammonium thiocyanate. From the quantity of silver nitrate consumed, content of tolbutamide is calculated.

The interference of common excipients and lubricants used in the manufacture of tablets are also studied. The method has been found suitable for estimation of tolbutamide in pure state and in the form of tablets, the form in which this popular antidiabetic drug is administered.

20. Sandflies of Punch and Riasi districts of Kashmir.

R. D. MITRA, Ahmedabad.

The distribution of sandflies and their relation to disease in Punch and Riasi districts of Kashmir was studied from January, 1954 to June, 1956. These are mountainous districts where the climate ranges from tropical heat to semi-arctic cold. The average annual rainfall is about 60 inches. The relative humidity during monsoon is about 82% and it is about 45% during winter.

The population of these districts is 117556 and 129285, respectively. The standard of living is low, dwelling houses are primitive. Cattle raising and agriculture are the main occupations. Water from streams and rivers is used for irrigation and domestic purposes. Sanitation is poor.

Malaria is hyper-endemic, the spleen rate and parasite rate are high amongst the local children Mite borne typhus and tick borne relapsing fever are endemic. Occurrence of louse borne typhus and relapsing fever is strongly suspected in these districts. The morbidity rate is considerably high during the warm months. Excremental diseases, enteric fever, small pox and mumps occur here. Intestinal worms, scabies and other forms of dermatitis are common. Personal hygiene is poor. Louse infestation in the population is high.

Prior to this investigation occurrence of sandflies in Punch and most of Riasi districts was not known. During this survey it was noted that sandflies appear from May to October. These insects shelter near living rooms, in low, partially open sheds for domestic animals. They are also found in the cracks of wall plaster, crevices between the bricks and dusty shelves up to a height of about 4 feet. When the climate becomes warm they disappear from such partially open places to cool, dark and closed rooms having floors littered with animal droppings.

83 collections made during 1954 and 1955 from 6 townships of Punch and Riasi districts, fetched 374 sandflies. 7 species of sandflies are recorded from this area. 3 well known vector species, viz., *P. papatasii*, *P. sergenti* and *P. chinensis*, are found here.

Distribution of *P. papatasii* is confined to the south of Riasi district. Its numerical prevalence in nature is high. It is found from June to October. *P. sergenti* is the most prevalent species uniformly distributed in both the districts and is found from May to October. *P. chinensis* is found only in Punch district during May and June. Its density of prevalence is low.

Sandfly fever has not been recorded from these districts but during summer and autumn in Riasi district a short term fever occurs amongst new comers hailing from the nearby hilly districts. It is not known if *P. papatasii*, which is prevalent in this area, causes the fever. *Cutaneous lieshmaniasis* occurs in the river valleys of these districts. Kala-azar has been reported from Raisi district but further investigation is required to ascertain its endemicity here. The epidemiological conditions prevailing in these districts are hardly conductive for the dissemination of Kala-azar during any part of the year.

21. A study on excretion of some nitrogenous constituents in urine in normals.

M. L. PAI Baroda.

Eighteen normal male healthy subjects of ages varying between 17 and 22 years and living on this side of the country namely, Gujarat, have been studied for their daily urinary excretion of urea, creatinine and uric acid. The urinary urea excretion ranged from 5·6 to 16·1 gms. per day, with the average value of 11·1 ± 0·165 gms. per day. This is much lower as compared with the corresponding standard value given for Westerners, which is 30 gms. per day. The excretion of creatinine in urine in the subjects varied from 0·81 to 1·50 gms. per day with the mean value of 1 08 ± 0·043. The urinary excretion of uric acid ranged between 0·10 and 0·61 gm. per day with the mean value ot 0·32 ± 0·042. The values for the latter two constituents were slightly lower than the corresponding figures for Westerners. The average total protein content of the diet taken daily by the subjects was 59·1 gms. with a range of 53·8 to 76·1 gms. This intake of dietary protein seems to be lower than the standard value recommended by League of Nations' Health Committee. The diet of the majority of the subjects was mostly of the vegetarian type, which included rice, 'chapati', 'tuver-dahl' prepared in the form as it is usually consumed by the people of Gujarat. The vegetables, consumed were mostly leafy in type, seen as radish or 'tandulja', and sometimes 'dudhi', cabbage and cauliuower etc. which are particularly in abundance in different seasons of the year. This diet was thus low in animal proteins as compared to the animal protein rich non-vegetarian diet. It appears, therefore, that the vegetarian type of the diet, may perhaps be responsible for much lower urinary urea excretion in them. These findings once more demonstrate that the Western values of urinary excretion of urea etc. cannot be accepted for Indians for whom different values obtained after studies made on subjects of the different regions of the country, will have to be accepted.

22. The oxygen consumption of the liver tissue of golden hamsters infected with *Leishmania donovani.*

ANJALI CHATTERJEE and P. C. SEN GUPTA, Calcutta.

The oxygen consumption of liver slices from normal golden hamsters and those infected with *Leishmania donovani* have been studied with the help of the Warburg apparatus. Krebs-Ringer phosphate has been used as the suspending media with 0·2 M glucose and 0·02 M succinate as substrate. In a series of six experiments consisting of six normal hamsters and six infected hamsters the amount of oxygen consumed by the liver slices of the infected animal was slightly higher in the glucose substrate and definitely higher in the succinate substrate. Simultaneous histological study revealed cellular infiltration to be the prominent feature with slight or no degenerative changes in the liver of the infected animals. Higher oxygen consumption in the infected cases is probably mainly attributable to these accumulation of foreign cells, the leishmania requiring only minute amounts of oxygen.

23. Cytochemical pattern of the normal megakaryocyte.

P. C. SEN GUPTA, ANJALI CHATTERJI, J. B. CHATTERJEA and SANDHYA GHOSH, Calcutta.

Cytochemical methods have been applied by several workers to study the megakaryocyte. Literature on the subject indicates that the cytoplasm contains ribonucleic acid (RNA) and glycogen but the reaction for alkaline phosphatase and sudanophilic material was doubtful. There were no peroxidase positive granules and the nuclear chromatin showed the presence of desoxyribonucleic acid.

Detailed cytochemical study of megakaryocyte in wet-fixed smears and histological sections of bone-marrow obtained by sternal puncture has been carried out. The bone-marrow was obtained from individual showing normal platelets counts and appearance and normal megakaryocyte as seen by the Romanowsky's stain.

Results :

The nucleus of the megakaryocyte is made up of DNA, RNA and protein and contain the enzyme alkaline phosphatase. The cytoplasm is made up of ribonucleoprotein. It contains a small amount of glycogen but a considerable amount of acidic mucopolysaccharide which is not of the hyaluronic acid type. This acidic mucopolysaccharide is mainly responsible for the positive PAS reaction and glycogen is a relatively minor component. The cytoplasm contains a small amount of neutral lipoids and phospholipids. It shows a distinct reaction for alkaline phosphatase.

24. Observations on vitamin B_{12} binding capacity of serum.

D. K. BANERJEE, SANDHYA GHOSE and J. B. CHATTERJEA, Calcutta.

Vitamin B_{12} binding capacity of serum was estimated after adding 5,000 μμg vitamin B_{12} in vitro to 1 ml. serum and incubating at 37°C for 2 hours.

In normals, the mean binding capacity was 1,248 μμg per ml. and the range varied from 600—2,425 μμg per ml.

In nutritional macrocytic anaemia the mean binding capacity was 580 μμg per ml. and the range varied from 137—1,710 μμg per ml.

In aplastic anaemia, the mean binding capacity was 558 μμg per ml. and the range varied from 300—715 μμg per ml.

In chronic myeloid leukemia the mean binding capacity was 5,770 μμg per ml. and the range varied from 1,050—9,075 μμg per ml.

25. Racemisation of adrenaline in therapeutic adrenaline solution.

S. K. GANGULY, Calcutta.

One of the causes for the diminution of pressor activity of 1·0% adrenaline in adrenaline chloride solution has previously been reported from this laboratory to be due to racemisation of l-adrenaline to dl-form, which possesses half the pressor activity of the l-isomer.

In the present investigation the change of optical rotation of l-adrenaline chloride in therapeutic concentration (0·1%) at pH 2·6, with consequential change of pressor activity has been recorded. The pressor activity of the solution of l-adrenaline has been found to bear a relation with the specific rotation as follows :

$p = K + 0{\cdot}009435\,n$, where p is the pressor activity, $K (= 0{\cdot}5)$ the pressor activity constant for dl-adrenaline in relation to l-adrenaline, 0·009435, the ratio of K and the specific rotation and n stands for the observed sp. rotation (disregarding the sign). The relationship has been found to hold good in the determination of the pressor activity of adrenaline in l-adrenaline solution with a deviation of ±10% of the bio-assay method, when no other change in l-adrenaline except racemisation has taken place.

Since therapeutic adrenaline preparations as adrenaline tartrate and adrenaline malate are now being used in medicine, study has also been made to note the change of optical rotation of l-adrenaline in these solutions under the similar storage conditions. For this, l-adrenaline base was separated by adsorption chromatography, using cation exchange resin, Amberlite IRC-100 and elution with ammonia, from l-adrenaline d-tartrate and l-adrenaline l-malate in therapeutic concentration (0·1%, PH 2·9)

The degree of racemisation of l-adrenaline in l-adrenaline d-tartrate was much less than l-adrenaline in adrenaline chloride solution and it was negligible in l-adrenaline l-malate solution, when stored at 25-30° for a period of 2 years. Adrenaline malate thus appeared to be the most stable adrenaline solution for therapeutic use.

26. Observations on the incidence of ano-genital manifestations associated with chronic amoebiasis.

K. C. SAHU, Cuttack.

During the last six years investigations were carried out on 1074 patients suffering from different dormal manifestations : these were leucoderma, allergic dormatitis, depigmentation of skin, urticaria hyperpigmentation of skin, painful excoriation of anus, anal ulceration, vaginal ulceration, leucorrhoea, and ulceration of penis. These were received from different parts of Orissa in out-patient and in-patient department of Skin and Venereal diseases of the S. C. B. Medical College and Hospital, Cuttack.

Dermal menifestations of the ano-genital organs due to amoebiasis was observed in 320 cases. Out of these, painful excoriation of anus occurred in 1·3%, anal ulceration in 0·3%, vaginal ulceration in 0 3%, leucorrhoea in 0 3% and ulceration of penis in 0·3% of cases.

One of the above cases presented anal ulceration with punched out appearance with serofibrinous and cellular exudates due to lytic effect of amoeba. Phagedaenic ulceration of penis and ulceration of scrotum were encountered in another case of chronic amoebiasis. Amoebic ulceration of vagina on the left labius major, following upon intestinal amoebic infection was observed in yet another case. The three cases presented above had shown all the signs suggestive of syphilitic ulceration. In another case with profuse serofibrinous discharge, soreness of valva and vagina and burning sensation during micturition, two punched out ulcers were found, on examination, on the vaginal mucosa.

27. Some observations on Yaws in Orissa.

K. C. SAHU, Cuttack.

Yaws is a disease which is quite common in India, its incidence being fairly high in the contiguous states of Orissa, Andhra and Madhya Pradesh.

In Orissa the disease is mainly confined to the agency tracts in the districts of Koraput, Ganjam, Keonjhar, Maurbhanj, Sundergarh and Kandamal. The Yaws infected tract extends from Maurbhanj district in the north to Koraput in the south, and the coastal districts in the east to Sundergarh in the west.

The incidence is very high in the districts of Koraput and Ganjam, comprising an area of about 10,000 square miles in the state of Orissa. In Koraput district, Malkangiri taluk and Raygara subdivision are the worst affected areas.

In Orissa the disease is more prevalent among the Adibasis who comprise the following tribes: Gond, Kondh, Sourajatapu, Hondera, Pana Dana, Paraja, Godava Bagata, Dibayi, Koys, Bonda, Tharia and Dharma.

Infection is predominantly a disease of childhood. Amongst the Adibasi children under age of 5 years the incidence of the disease is about 90 per cent. During the rainy season the incidence goes further high, particularly in villages near streams and rivers.

The economic condition of these Adibasis who live in these regions is very low, their living conditions and personal hygiene are poor. They build small dingy dark huts made of palm leaves with a floor space of 4—8 ft. x 8—10 ft. which provide shelter to 10 to 18 people along with their domestic animals. These huts are infested with flies, bugs, rodents and lice, regarding which investigations are in progress to determine their role as the possible vectors.

28. Striae albicantes due to bad sitting posture.

K. C. SAHU, Cuttack.

The changes in the cutaneous system above the knee joint and the back above the sacrum were found amongst students due to mechanical stretching of the skin striae as a result of bad sitting posture by putting the folded knee joints against the table and back streched by sitting almost over sacrum. In recent state they are pinkish and linear in outline and spread transversely. These changes infused in their mind the fear of leprosy for which each of them sought the opinion of the author. This depends on the capacity of skin to resist the effect of streching in different individuals. It has been observed in 13 cases over a period of 2 years in the Skin and V. D. clinic of S. C. B Medical College and Hospital, Cuttack.

29. Some protein changes in guinea pigs following B.C.G. vaccination and infection with *M. tuberculosis* $H_{37}R_v$.

MISS M. INDIRA and M. SIRSI, Bangalore.

Serum protein changes reflect the severity of the tuberculous infection, normalcy being regained with the recovery from the disease B.C.G. vaccination while conferring a certain degree of immunity is known to cause an initial generalized infection and later regression of the lesions. It was considered desirable to investigate the pattern of protein changes during the development of immunity after vaccination as also during the course of infection of these immunized animals. These findings have been compared with the protein changes of non-immunized healthy guinea pigs infested with the same dose of virulent tubercle bacilli, and later treated with INH. The protein patterns were studied by the agar-gel electrophoretic technique.

The main features of the results obtained were:—

1. *In acute infection of normal guinea pigs*: A fall in the albumin level and rise in all the globulin with no alteration of the total proteins in the earlier phase of infection; a steep fall in albumin and increased rise in all the globulins with hyperproteinemia in the later stages.

2. *Treatment with INH* raised the lowered albumin and decreased the β-globulin levels. But α and the γ globulins were still at a higher level.

3. *After B.C.G. vaccination*, no alteration in the albumin concentration, but a slight fall in α_4, α_2 and β-globulin and an increase in the γ-globulin associated with hypoproteinemia was the early reaction. From the second month onwards, an increase in α_4, α_2 and β-globulins associated with hyperproteinemia was observed. These trends lasted till the experimental period of 6 months. No changes in the albumin

concentration was seen during this period. γ-globulin which initially showed an increase, declined from the 3rd month onwards. Tuberculin reaction became positive from the third week onwards and exhibited almost the same intensity of reaction throughout this period.

4. *During the development of tuberculosis in the immunized animals,* at the end of 2 months there was no further increase in the total proteins or a large fall in the albumin concentration; α_1 globulin remained at the immunized level; α_2, β and γ-globulins showed an increase, the latter to quite an appreciable extent.

Significance of these changes in the individual components in relation to immunity and infection are discussed.

30. Dermal manifestations in malnutrition syndrome of children.

K. C. SAHU, Cuttack.

Dietetic errors are common in this country, due particularly to imbalance and faulty feeding. An excess of carbohydrate especially in the form of starch fed usually at an early age may be cited as an example. The loose, green acid and frothy stool when passed frequently corrodes the anal region especially the buttock. Uncorrected diarrhoea leads to severe and fatal marasmus. Deficiency disease like protein deficiency, common among children results in devitalization of tissue which become worn and degenerated. Infections may often set in but excoriation of skin and vulva and anus is of usual occurrence. The area of skin involved are behind the ears, around the mouth and the eyes. These are the symptoms usually associated with the various forms of avitaminoses. Out of 863 cases admitted in the baby ward of S. C. B. Medical College Hospital, year 1957, 162 cases were due to malnutritions associated with skin manifestations described above.

31. Comparative study of serological tests for Syphilis.

K. C. SAHU, Cuttack.

The V.D.R.L., newer rapid test of blood compares favourably as regards sensitivity and specificity with the older W.R. test. Out of 330 suspected cases of syphilis of the S. C. B. Medical College Hospital, blood from 50 cases gave positive result for the W.R. test and 56 cases were found positive to the VDRL test, thereby indicating that VDRL test is as sensitive and specific as the W.R.

32. A study of haemagglutination reaction of serum of Leprosy contacts.

A. N. ROY, Calcutta.

Authorities consider that children are specially liable to infection to leprosy through close association with lepers. Repeated examination of all contacts for cardinal signs of leprosy has been advocated for control of leprosy as there is no other test for early detection of leprosy in such contacts. In the earliest stage of an infection with Myco-leprae or the stage of silent phase of the disease, the skin of the person infected by the micro-organisms does not show any blemishes attributable to the disease. It is claimed by some authors that bacilli are present in the tissues of healthy contacts of leprosy patients which can be detected by concentration method (Khanolkar). If the bacilli are there in the tissues, possibility of production of antibody in the blood is postulated. Haemagglutination test method applied to the sera of leprosy contacts shows that early detection of infection by this technique is possible. More than 31 per cent of 145 contacts examined by this method demonstrated presence of antibody in the blood of the contacts. Use of this test for early detection of leprosy and for epidemiological survey is suggested.

33. Nocturnal periodicity of biting midges (Diptera: Ceratopogonidae).

P. SEN and S. K. DAS GUPTA, Calcutta.

The paper records the pattern of nocturnal incidence in three well-known species of biting midges, *Culicoides alatus*, *C. anophelis* and *C. peregrinus* from light trap studies. Whereas the general pattern is to have the peak at the first part of the night (7 to 10 P.M.) gradually diminishing towards early hours of the morning (1-30 to 4-30 A.M.), *C. anophelis* has the lowest incidence during the middle part of the night (10-15 P.M. to 1-15 A.M.), the sexes in the last-named species being equally involved. In the other two species while the female maintains the general pattern as stated above, the male deviates from it. The authors consider the previous reports showing the incidence of *Culicoides* depending on human or animal bait involving different age-groups and sexes as misleading as the observations did not take into account of the entire population complex of the species dealt.

34. Neuromuscular relaxation with Berbamine hydrochloride.

S. C. LAHIRI and K. N. SEN, Calcutta.

Berbamine is a *bis*benzyl*iso*quinoline alkaloid found in the root and bark (0·5–2·0% yield) of many species of *Berberidaceae*. The present authors have previously shown it to have some hypotensive and antibacterial properties. In view of the two quaternary nitrogen atoms in berbamine hydrochloride and its structural similarity to d-tubocurarine chloride it was investigated for neuromuscular relaxant activity. Cat sciatic nerve-gastrocnemius preparation and isolated frog rectus preparations were employed. Neuromuscular relaxation was found in cat gastrocnemius with intrarterial doses of 0·75 mg./kg. and over. The paralysis took 15—30 minutes to develop and disappeared in about an hour. Neostigmine antagonized Berbamine-induced paralysis. When given along with berbamine hydrochloride the degree and duration of paralysis was reduced. The ED 50 in frog rectus was 16·57 ± S.D. 3·86 μG/ml. The mode of action of the drug has not yet been elucidated. But since neostigmine antagonism occurs, and since it antagonizes acetylcholine induced contraction in frog muscle, the mode could possibly be curarimimetic. If quaternary analogues with side chain substitutions could be developed, promising muscle relaxants may come to light.

VETERINARY SCIENCES

35. Infectious muco-epitheleitis : A new viral disease of buffaloes.

P. G. PANDE and D. KRISHNA MURTY, Mathura.

During recent years considerable attention has been devoted to a newly recognised group of bovine viral diseases characterised primarily in diarrhoea and erosions of the alimentary tract. These diseases have been given the label of 'Mucosal disease complex' but present a very close clinical and pathological resemblance to rinderpest although the etiological agents are immunologically different.

From the various States of India where mass vaccination campaign against rinderpest is in operation, field workers have reported the occurrence of a milder form of rinderpest with the obvious gross lesions but characterised further by a slight or no rise of temperature, a high percentage of morbidity and low mortality figures. On encountering such symptoms and lesions in herds where vaccination against rinderpest had been undertaken breakdown of immunity against rinderpest has been reported. In our investigations in Uttar Pradesh we have encountered during recent years, several cases of breakdown of immunity in vaccinated animals, involving particularly a large number of buffalo herds, and detailed investigations undertaken on one such outbreak at a State livestock farm revealed the occurrence of a new viral disease which is immunologically distinct from rinderpest, although possessing a close clinical resemblance to it. Detailed account of the clinical observations and the transmission experiments have been recorded in this paper. The virus was found to be specific to buffaloes but did not affect either cattle, sheep and goats or any of the laboratory animals. The recovered animals were found to be resistant to re-infection with this virus. Attempts to cultivate this virus in developing chick embryos were not successful.

In view of host specificity of the virus and the nature of the disease its close similarity to rinderpest yet representing a distinct disease entity the condition has been labelled as 'Infectious Murco-epitheleitis'.

36. Effect of Interval between collections on the reaction time and semen of Indian Zebu bulls.

S. GAJJAN SINGH and S. S. PRABHU, Izatnagar.

Experiments were conducted on six *Hariana* and ten *Kumaun-hill* bulls to study the effect of frequency of collection on the reaction time and semen quality. Per collection, two ejaculates in rapid succession were taken. Two frequencies of collections were tried. They were once a week and twice a week. Each ejaculate was typed for volume, motility, pH, % abnormal sperm, sperm concentration and total sperm in ejaculate. The bulls in each breed were equally divided between the two frequencies (treatments) using a randomised block design. The *Hariana* experiment lasted for 2 months and the *Kumaun-hill* experiment for 4½ months.

Analysis of data revealed that an increase in the frequency of collection from once to twice a week, significantly increases the reaction time, and significantly decreases the semen volume, percentage of abnormal sperm, concentration of sperm and total sperm in ejaculate, while no marked effect was noticed in case of initial motility and pH within the limits studied.

37. A note on the interference phenomenon, as a natural weapon to combat Newcastle disease outbreaks while using Mukteswar virus vaccine.

B. R. GUPTA and S. B. V. RAO, Izatnagar.

Sixty chickens of 6 weeks of age were vaccinated with Mukteswar Newcastle disease (N.D.) or Ranikhet freeze-dried vaccine. Four chickens from this lot were challenged every 24 hours up to 10 days with a virulent N.D. virus, along with 2 controls. Forty-eight hours after vaccination 50 per cent of the chickens were refactory to the disease, and in 72 hours mortality entirely ceased. Haemoagglutination inhibition (H.I.) bodies could not be demonstrated in the blood up to 5 days, and the protective index H.I. power of 80 (correlated with serum neutralization antibodies) was not reached up to the seventh day among the vaccinated birds. Hence the protection from 72 hours to 7 days against an actual challenge, under the cover of which the specific antibodies developed against N.D. can only be explained as due to an interference phenomenon or cell block reaction by the earlier vaccine virus. This phenomenon has practical importance in the control of the disease when live vaccine is used in an outbreak on apparently healthy fowls after removal and destruction of visibly ailing ones.

38. Studies in the immunization of chickens against spirochaetosis. Part III. Immunity studies.

S. B. V. RAO and B. R. GUPTA, Izatnagar.

1. Previous studies (Rao *et al,* 1954) with the wet vaccine showed that it induced immunity against an experimental challenge after 21 days, but the present studies with the freeze-dried merthiolated vaccine was found to confer immunity within 10 days of vaccination against an actual challenge dose of spirochaetes in virulent blood, and also

2. That tick fever vaccine has no advance effect on *growth rate* in young ones or egg yield in adults.

3. That simultaneous vaccinations with Fowl pox virus and Tick fever vaccine did not militate the production of respective antibodies, and both induced 100% immunity in the presence of each other. That early vaccination of chickens when day-old proved valueless. That 5000 field vaccinated birds against tick fever showed no untoward sequelae, but were protected against tick fever infection. Controlled experiments in 1066 birds on the field proved 100 per cent of the birds to be solidly immune to both field as well as laboratory challenge with virulent virus.

An instance of the mechanical transmission of tick fever by bed bugs was also recorded during the course of this work.

39. Studies in the immunization of chickens against spirochaetosis. Part II. Recent advances in vaccine production.

S. B. V. RAO and B. R. GUPTA, Izatnagar.

The previous vaccine (Rao *et al* 1954) though highly immunogenic was capable of further improvement in preparation, preservation and handling.

(1) Correlation studies were made in infected embroys and it was found that certain syndromes were constantly associated with infected embryos with a high content of spirochaetes in the blood, and this finding has made it easy in selecting such embryos for vaccine production, and to avoid the necessity of checking by straining and microscopic examination of the blood of numerous embryos. (2) As the wet embryo tissue was too thick, and blocked the needle in field vaccinations and also constantly sedimented in the containers, freeze drying of this product has removed both these difficulties as the reconstituted material is a fine homogenous suspension of the embryo. (3) The *addition of merthiolate* in place of formalin has improved the antigenicity of the vaccine in the *freeze-dried* product. (4) The dose of the freeze-dried product was fixed at 0·1 to 0·12 gms. of the wet material per chicken weighing from 1 to 5 lbs. (5) An embryo weighs 5 gms. after dismembering head and legs, *and 40 to 50 chickens* can be immunized with the vaccine produced from *one embryo.* The dry weight of the embryo is 0·6 gms. and is tubed in 2 ampules containing 0·3 gms. each, and 20-25 chickens are immunized with each freeze-dried vaccine tube.

40. Studies in the immunization of chickens against Spirochaetosis. Part I. Evolution of a vaccine strain and its maintenance.

S. B. V. RAO and B. R. GUPTA, Izatnagar.

Spirochaetosis commonly known as tick fever in chickens is one of the formidable disease conditions prevailing in this country, especially in the northern latitude. At present there is no effective vaccine for its control.

By serial passages of the infected blood in fowls a strain was maintained for years at the Mukteswar branch of the Institute. This strain was used to produce infection and just at the onset of the first reaction to the inoculation, the condition was cured by chemotherapeutic measures.

Owing to the various limitations in the above technique of prophylaxis, experiments were initiated to isolate another suitable strain and to develop it by chick embryo passage into a safe and potent antigen for effective immunization. With this end in view a new field strain was adopted for use as the embryonated tick fever vaccine.

Out of the four strains isolated from field outbreaks a vaccine strain was evolved by 12 serial passages in chicken embryos by drawing blood by intravenous puncture from the batch of infected embryos and inoculating into the next batch by the yolk sac (Y/S) route, and subsequently by twenty-five further passages in embryos by using infected embryo liver suspension as inoculum for Y/S passage. These passages resulted in the modification of a field strain of spirochaetes which multiplies rapidly in chick embryos and has a regular death pattern with a 50% kill in 7 days old embryos when inoculated in 0·2 ml. quantities by the Y/S method after 7 days of incubation. As the field strain under passage would not stand citration, necessary to keep the blood fluid for easy embryo-passage and preservation between passages, it was gradually subjected to citration until it remained viable in 0·25 per cent final concentration. This was held in refrigerator for longer and longer periods between passages at different temperatures, and has now been finally fixed at 10°C. (usual refrigerator temperature) for 21 days; and thus the maintenance of the strain has become an easy routine as before.

41. Studies on the indigenous fowl.

S. G. IYER, S. BOSE, H. P. TANDON and C. M. SEN GUPTA, Izatnagar

As the Izatnagar strain of *Desi* breed which was evolved by selective breeding with an average annual egg production of 140, started to show somewhat unsatisfactory results regarding hatchability, viability and egg production, as a result of 15 years of close inbreeding, experiments were initiated to cross them with Brown Leghorn due to their similarity of the plumage colour and backcross the F_1 hybrids in successive generations to the Izatnagar strain of *Desi* males. The results showed that the introduction of Brown Leghorn blood into the Izatnagar Desi breed considerably improved the performances of F_1 hybrids, as regards viability and egg production.

42. Studies on the comparative and complementary effect of fish meal and separated milk in the feeding of growing chickens.

S. BOSE, C. M. SEN GUPTA, K. K. AGARWAL and S. G. IYER, Izatnagar.

The present investigation was carried out to study the comparative and complementary effect of fish meal and separated milk in the growth of chickens. The experiment consisted of chicks divided into three comparable groups. The protein content of the rations was 18 per cent in each of the three groups. It was observed that the ration of Group I containing separated milk was 12·5 per cent superior to the ration of Group II containing fish meal. As separated milk is much more expensive than fish meal, the difference in cost between the rations is an importnt factor in determining the more economical poultry ration. The ration of Group III, containing separated milk and fish meal in combination proved highly superior to the ration of either Group I or Group II. The combined percentage increases in body weight of the male and female chickens of Group III over Group I and Group II, at the end of eight weeks were 9·2 and 22·9 respectively. The experiment shows that fish meal and separated milk, fed in combination, produce complementary effect in stimulating the growth of chickens.

43. The value of Penicillin Mycelium Residue as a protein supplement in growing ration.

S. BOSE, C. M. SEN GUPTA, K. K. AGARWAL and S. G. IYER, Izatnagar.

The Penicillin Mycelium Residue, a waste product of the Penicillin Factory, is rich in protein and growth-promoting factors. The present investigation was carried out to study the value of Penicillin Mycelium Residue as a protein supplement with and without supplementation with fish meal and Terramycin antibiotic feed supplement The results showed that Penicillin Mycelium Residue at 10 per cent level (group I) without any animal protein supplement produced moderately good growth. The addition of Terramycin antibiotic feed supplement (Group III) stimulated the growth of chickens by 3 8 per cent. The inclusion of Penicillin Mycelium Residue and fish meal in combination (Group II) produced 9 6 per cent increased growth over Group I. The supplementary effect of the addition of fish meal was due to better assortment of amino-acids of the proteins. The further improvement in the growth was effected in Group IV which was supplemented with Terramycin in addition to Penicillin Mycelium Residue and fish meal. The combined percentage increases in body weight of male and female chickens of Group IV over Groups I, II and III at the end of eight weeks were 27 1, 15 9 and 22.4 per cent respectively.

44. Studies on the inclusion of a high level of groundnut cake in growing poultry ration.

S. BOSE, C. M. SEN GUPTA, K. K. AGARWAL and S G. IYER, Izatnagar.

The groundnut cake is rich in protein and readily available in abundance in India. The relative prices of cereals and groundnut cake, therefore, favour the increased use of groundnut cake for formulation of economic poultry rations. The present investigation was designed to study the effect of the inclusion of high level of groundnut cake in growing poultry ration containing both separated milk and fish meal in combination, so that the ration remained adequate in both high quality proteins and vitamins. The results show that the experimental ration containing 57 per cent groundnut cake supplemented with both separated milk and fish meal prove highly satisfactory in the growth of chickens, leading to considerable economy in the use of cereals for the production of stock. The average body weights of the chickens in the control and experimental ration, at the end of eight weeks, were 454 g. and 476·5 g. respectively. It appears that the addition of separated milk has proved beneficial to the ration containing high proportion of groundnut cake by making available important vitamins, especially riboflavin.

45. Efficiency of mineral oil and lime water for preservation of eggs.

T. D. MAHADEVAN, Izatnagar.

An experiment was undertaken to compare the efficiency of the mineral oil (supplied by Burma Shell Oil Co.) with that of lime water for preservation of eggs in shell.

Results of the test led to the conclusion that both oil and lime water are about equally efficient in preservation of eggs.

It was observed that whereas fertile eggs when used as controls became rejects due to embryo development in 3-4 days and the infertile ones barely lasted a fortnight, the infertile eggs when treated with the above preservatives and kept at room temperature remained wholesome for about 14-16 weeks.

Since the oil did not have any overall advantage over the lime water and since lime water is cheaper than the oil, it seems that lime water could be used as an egg preservative even by the village producers with advantage.

This experiment clearly proves that the use of these preservatives help considerably in conserving the quality of eggs over reasonably long period during summer months, even if kept at room temperature, provided the eggs used are infertile.

46. Utilization of urea as a protein substitute in the ration of growing (buffalo) calves.

N. D. KEHAR, P. C. SAWHNEY and K. N. PARAMESHWARAN, Izatnagar.

In view of the acute shortage of protein rich concentrates and encouraging results obtained in Western countries on the use of urea as a protein substitute for ruminants, it was considered advisable to study the effect of utilising urea as a protein substitnte in the ration of growing calves.

Twenty-five buffalo calves were selected and divided into five groups of five each. The five groups represented one of control, three experimental receiving urea supplement at the rate of 10%, 20% and 30% of the protein requirement respectively and a fourth experimental group in which animals received only 70% of the digestible crude protein requirement, provided solely by conventional protein source—calf mixture. The rations of the animals of the various groups were made isocaloric by adding starch to the ration of the experimental groups.

The feeding regime which commenced on 18-10-57 will extend over a period of one year. The animals were weighed at weekly intervals. The data on the growth will be subjected to statistical analysis; after the completion of the feeding regime.

A metabolic trial was conducted after a period of about 7 months. There was practically not much difference in the digestibility coefficients of crude protein and other extract in the five groups. However there appeared a tendency of decrease in the digestibility coefficient of crude fibre with the increase in the amount of urea in the ration.

The total digestible nutrients of rations, per 100 lb. dry matter, were 61·38 lb., 61·16 lb., 62·98 lb., 63·33 lb. and 61·08 lb. for the control groups and experimental groups I, II, III and IV respectively.

The animals of the five groups were in positive balance for nitrogen, calcium and phosphorus.

47. The effect of feeding different levels of urea on the composition of blood of growing buffalo calves.

N. D. KEHAR, P. C. SAWHNEY and K. N. PARAMESHWARAN, Izatnagar.

Favourable results have been obtained in Western countries on the use of urea as a protein substitute for ruminants. The present study was conducted in order to see the effect of urea on the composition of blood of growing buffalo calves.

In this study three experimental groups received urea at different percentage levels of the digestible crude protein requirements, a fourth group was maintained on 70% of the digestible crude protein requirement and a fifth group was kept as control. The rations of the animals were made isocaloric by the addition of the requisite quantity of starch to the rations of the experimental groups.

Blood studies were undertaken on the buffalo calves in all the five groups during the pre-experimental period and then again seven months after the experimental feeding.

It was found that the inclusion of different levels of urea in the rations of the growing calves had no effect on the morphological characters and chemical constituents of the blood.

48. Pathogenicity of Beta Staphylotoxin for rabbit kidney.

S. N. BAKSHI, Lucknow.

The pathogenicity of Beta Staphylotoxins of different haemolytic titer for rabbit kidney was studied by inoculating 1 c.c. of the toxin in the ear vein. The rabbits were destroyed 5 days after inoculation and kidneys collected for gross and histopathalogical examination. The kidneys from rabbits given toxin of haemolytic titer 1 :1000 to 1 :2000 showed marked retrogressive changes in many of the glomeruli and renal tubules resulting into hyalinisation. Generally the glomerular capillary tuft was engorged with erythrocytes and showed leucocytic infiltration. The collecting tubules showed cloudy swelling of the lining epithelial cells and cell casts in the lumen. The blood vessels were found to be engorged and there were large areas showing extravascular erythrocytic infiltration. The intertubular interstitial tissue showed active fibroblasts.

The kidneys from rabbits inoculated with toxin of haemolytic titer of 1 :50 to 1 :200 showed comparatively milder changes resulting into cellular infiltration of glomeruli and cloudy swelling of the tubules. The capillaries were enlarged but there were no areas of haemorrhage. The interstitial tissue showed fibroblastic activity.

It is surmised that Beta Staphylotoxin is secreted by the renal glomeruli and it behaves as an irritant, bringing about the retrogressive changes of the epithelial tissue, engorgement of capillaries and proliferation of fibrous tissue, depending on the haemolytic titer of the toxin.

49. Efficiency of dilutors for the preservation of buffalo bull semen.

R. B. SINGH and N. S. TOMAR, Mathura.

For making a full use of artificial insemination in the case of buffaloes in this country, it is necessary to find out some dilutor in which the semen can be preserved for more than 3 or 4 days. The work done by the authors evolved a dilutor which consisted of egg yolk-sodium bicarbonate-glucose-fructose. Sodium bicarbonate, glucose and fructose were dissolved in double distilled water to the extent of 1·3%, 5% and 5% respectively. The dilutor was made by making 10% of sodium bicarbonate, 40% of glucose, 25% of fructose solution with 25% of egg-yolk. This dilutor could preserve semen up to +3 motility for longer period than egg-yolk-sodium citrate and egg-yolk-glycine. It could be used for insemination purpose for 6·25 days, where as the egg-yolk-sodium citrate and egg-yolk-glycine can be used for 3·5 and 4·25 days respectively. The pH value up to +3 motility is almost the same. The whole life of buffalo bull semen in egg-yolk-glycine is for a period of about 23 days, and in egg-yolk-sodium citrate, and egg-yolk-sodium bicarbonate-glucose-fructose is for a period of 12 days in each. As the whole life of the semen has little value for insemination purpose, the use of egg-yolk-glycine for preserving buffalo bull semen may be inferior to that of the dilutor egg-yolk-sodium bicarbonate-glucose-fructose.

50. Storage of buffalo bull semen in undiluted condition.

S. K. SAHA and R. N. DESAI, Mathura.

In all 33 semen samples were collected from seven different bulls and grouped into two classes; 24 of these having initial motility of +3 or above were put in class I and the rest of them with less than +3 were in the other. The average initial motility of the samples of the first group of +3·96 with a range of +3 to +5 and that of the second was of +1·06 ranging from +0 to +2 5. The samples in the second group gained in motility within the next 24 hours of storage from 1 06 to +1·44 and then gradually declined. The half average life of the samples of the first group was of 46 hours of duration while the full average life was of 168 hours with a range of 24 to 168 hours. Whereas only two samples out of nine from the second group gained in motility up to the insemination level i.e. +3 for 24 hours but others declined gradually. There was no significant difference in motility of samples collected from different bulls but the real difference existed between the two groups. The decline in pH and motility was found to be significantly related and most of the samples died with a pH ranging from 6·1 to 5·8.

51. Intercalving period of Murrah buffaloes in relation to the season of calving.

R. B. SINGH, S. C. SHARMA and SARTAJ SINGH, Mathura.

A study was made to see if the season of calving influences the intercalving period of buffaloes. The records regarding the period of calving and subsequent intercalving period in case of buffaloes maintained at District Dairy Demonstration Farm, Mathura, Mechanised State Farms, Madhurikund (Mathura), Babugarh (Meerut) and Bharari (Jhansi) were collected. 666 such calvings and intercalving periods were analysed and the result indicated that there are two seasons for calving in relation to the efficiency of intercalving period. The best period is covered from June to November and the worst is from December to May. The intercalving period is more by 78·4 days for those which calve during the latter season than those which calve during the former one. The average intercalving period per buffalo is 444·1±4·54 days. As the frequency of calving is more during favourable season, it seems nature helps in bringing buffaloes in heat more in a particular period depending upon the fodder conditions and other physiological functions of the body. It was also noted that the first intercalving period is longer than the subsequent ones.

52. Sex behaviour of Hariana bulls in relation to the type of dummy.

R. B. SINGH and S. C. SHARMA, Mathura.

Eight Hariana bulls were used to donate semen on two types of dummies namely Murrah buffalo bull and Hariana cow for assessing the quantity and quality of semen collected on different dummies. The reaction time was noted and the collected semen samples were evaluated for volume, initial motility, pH value density of sperm per c.m. and longevity of sperm in egg-yolk sodium citrate dilutor. The replacement of cow as dummy by a buffalo bull for the collection from Hariana bulls does not have any influence on the reaction time, quantity of semen, initial motility, pH value, sperm density and half average longevity. It is noted that the use of a male dummy has influenced the full average life of the sperms under storage. On the basis of the findings of this work it is concluded that buffalo bulls can safely be used as dummies.

53. Effect of blood-letting on the growth of *P. gallinaceum* in Bazar fowls.

N. K. ROY, A. N. BOSE and S. R. GHOSH, Calcutta.

In previous studies from this laboratory on the progress of parasitemia in *P. gallinaceum* in Bazar fowels, it was observed that parasitemia after an initial progress gradually declines in some birds. Though surviving longer than the infected controls, such birds develop neurologic complications, manifesting in severe cases as spasmodic contraction most marked in the extensor muscles of the neck. During the present work, it has been noticed that birds from which blood was withdrawn for experimental purposes lived longer than inoculated controls. After withdrawal of blood, they showed a gradual lowering of parasitemia and lived for months apparently quite healthy. In none of them neurologic complication did ever develop. Assuming that withdrawal of blood might result in some elimination of the parasite and its metabolic product which might affect progress, blood letting on a number of chicks and fowls at different levels of parasitemia was performed. As the young chicks seldom stood the withdrawal of blood, no definite observation about the effect of blood-letting on the progress of parasitemia and general health could be made. But in the case of fowls, it was confirmed that blood-letting even if followed by glucose administration causes a definite lowering in parasite density if the parasitemia, at the time of withdrawal of blood, does not exceed 20% level. In some of these birds, the parasites may even disappear in the peripheral blood, but sub-inoculation from these birds in fresh chicks and fowls always resulted in late appearance but sharp rise in parasitemia.

54. Preservation of buffalo bull semen in the varying strengths of sodium citrate.

R. N. DESAI and S. K. SAHA, Mathura.

In continuation of the preliminary studies on the preservation of bull semen in undiluted state, the effect of various strengths of sodium citrate varying from 1·5 to 3 6 per cent on sperms were studied under microscope. On comparing their effects the lowest of 2·5 and the highest of 3·0 per cent of the desirable levels of sodium citrate were chosen to study further the stimulating effects in terms of increased motility and duration of life under microscope at room temperature varying from 110 to 114°F. The level of stimulation was, found to be uniform for both the strengths. However, 2·5 per cent gave longer survival time by 90 minutes as compared to 3·0 per cent at all the stages of storage. Besides, the stimulating effects of both the percentages was much more marked from 48 hours of storage to 144 hours. This clearly indicates as deserved under the microscope that the sperm that appear to be dead because of their inactivity, can further be activated up to the extent of additional 1·5 degree of motility at various stages of storage from 72 to 144 hours by the addition of sodium citrate. Another important feature that was noticed. is that the sperms cells can remain alive for 3 to 5½ hours in 2·5 per cent sodium citrate on slide at extreme room temperature of 110 to 114°F. These findings indicate the possibilities of diluting the semen with extenders containing sodium citrate at different levels within 2·5 to 3·0 per cent with encouraging results. Thus the semen samples diluted at 24 and 48 hours of storage with 2·5, 2·75 and 3·0 per cent sodium citrate solutions and 50 per cent egg yolk not only maintain the motility at higher levels but also prolongs the life of sperms by 24 to 30 hours.

55. Amino acid composition of seed kernels of mango fruits *(Mangifera indica)*

JYOTIRINDRA DATTA and KSHIROD R. BHATTACHARYA, Calcutta.

Amino acid contents of the seed kernels of four varieties of mango (*Mangifera indica*) were quantitatively analysed by conventional paper chromatography to ascertain the nutritive value of their proteins in relation to their use as fodder. The seed kernels are very low in protein (4·5% on a dry basis). All the common essential and non-essential amino acids are present in fairly balanced proportions. However, the amount of tryptophane, tyrosine, threonine and methionine are somewhat low. There is no significant difference in the quantitative distribution of amino acids in all the samples.

It is suggested that inspite of the low protein content, the seeds have fair prospect as fodder supplement because of their easy accessibility and because of the favourable distribution of the amino acids in these samples.

56. A case of *Aspergillus fumigatus* infection causing dermatomycoses in goats.

A. N. GUHA, Calcutta.

On a survey work of mycotic diseases in animals the author came across skin lesions, in the inguinal region, including the scrotum of a goat.

The lesions presented were dry, inflammatory and granulomatous in nature but showing no ulceration. The animal was exhibiting intense feeling of itchyness at the site of infection. It was treated with various drugs e.g., different dyes, salicylic acid ointments and antibiotics including sulfa drugs, for about 3 months but with no sign of cure or improvements.

Materials were collected and subjected to microscopical, cultural and biological tests and the organism isolated was typed as a strain of '*Aspergillus fumigatus*' and the strain proved pathogenic for another goat on subcutaneous inoculation.

As far as is known, this is the first report of *Aspergillus fumigatus* infection in animals, other than poultry, in India, and is the first case of isolation of this fungus from pathological processes in goats.

57. Studies on serum cholesterol level in hyperthermic pigeons.

B. N. CHAUDHURI, S C. CHOWDHURY and D. P. SADHU, Calcutta.

Hyperthermia was induced in pigeons by exposing them to an environmental temperature of 45°C Serum cholesterol was estimated before and after incubation. It has been observed that after 1 and ½ hours incubation the total cholesterol level was not changed while the level of free cholesterol rose from a normal value of 61·50±5·50 to 66·30±4·50. The total cholesterol value before and after incubation was 127·30±5·00 and 118·70±3·50 respectively. After 6 hours incubation both free and total cholesterol level significantly rose, the values being 69·40±5·00 and 135·00±7·00. The possibility of a change in membrane permeability of the R.B.C. with consequent rise in free cholesterol level in hyperthermia has been discussed.

58. Studies on some histochemical activities of caprine intestine.

A. K. PUTATUNDA, A. K. CHOWDHURY and D. P. SADHU, Calcutta.

The distribution of alkaline phosphatase has been studied in the intestine of the goats of the Jumnapuree breed. Tissues were examined from three adult goats. Alkaline phosphatase was demonstrated by the method of Gomori. The distribution of the enzyme was found to decrease gradually from the epithelial to the muscularis mucosa and was present in the serosa of the coeca. Enzyme distribution was maximum in the duodenum, less in jejunum, decreased still further in the ileum and colon. The distribution of the enzyme seems to be related to the metabolic gradient.

59. The mode of ingestion in the common Indian poultry louse goniodes dissimilis Nitzsch. (Ischnocera : Mallophaga).

GEORGE PHILIP and S. MASIHOOD ALAM, Aligarh.

Goniodes dissimilis Nitzsch, an ectoparasite of domestic fowl, lives on the loose barbs of soft feathers of its host. Gnathal appandages assisted by modified labrum, complex hypopharynx, pulvinus and fore-legs aid in feeding. Pulvinus and anterior lobe of labrum clean the food. Fore-legs, reduced labium and ventral lobe of labrum hold it in possition to be cut by the strong mandibles. Hypopharynx and epipharynx help to move it to the mouth to be consumed finally by the movements of the pharyngeal wall. The authors agree with Snodgrass (1944) that Armenante's (1911) view on the function of sitophore as "isopogometer" is incorrect. It is shown that mechanism of cutting equal lengths of food is correlated with the range of movement of the fore legs during feeding. Functionally, the sitophore in Ischnocera is not so important as in Psocoptera. Saida Symmons's (1952) view on sitophore's function is not acceptable because in Amblycera even without cup-like sitophore the saliva and blood are sucked in. The lingual glands are for the first time recorded as functional. It is further suggested that their secretion is held by sitophore which like epipharyngeal crest shows reduction tendency.

60. Studies on nocardiosis of domestic animals—I. *Nocardia sebivorans* and *Nocardia aseroides* infection in sheep and goats.

M. N. DHANDA and P. CHANDRA SEKARIAH, Mukteswar-Kumaon.

During the course of an investigation carried out on the bacterial flora of the pneumonic lungs of 250 sheep and 150 goats, *Nocardia asteroides* and *Nocardia sebivorans* were isolated from six cases of pneumonia in sheep and four cases of pneumonia in goats. Those isolated from sheep were identified as *N. sebivorans* (4) and *N. asteroides* (2). The caprine strains comprised *N. sebivorans* (3) and *N. asteroides* (1).

This is the first time that infections with these two members of the genus *Nocardia* are being reported in sheep and goats in India as well as abroad. *N. asteroides* is a well-known pathogen of man and the isolation of such an organism from sheep and goats raised a fundamental problem of great public health importance concerning the animals as reservoirs of disease for man.

It is suggested that further studies on various mycotic infections in domestic animals should be pursued for a proper understanding of the control of these diseases in man and animals, as it is a problem of mutual importance to veterinarians as well as public health workers.

61. A case of human infection caused by *Pasteurella septica.*

M. R. DHANDA, S. GANGULI* and P. CHANDRA SEKARIAH, Kumaon.

Human infections with *Pasteurella septica* are being recognised now with greater frequency. The unusual features of the case of empyema reported here were the absence of any history of contact with any animal and lack of agglutinin response in the patient consequent on infection.

The strain of *P. septica* behaved peculiarly in that it failed to produce indole and reduced methylene blue milk. Other unusual features were the fermentation of xylose, maltose and trehalose but not arabinose as well as its inability to induce production of agglutinins in rabbits and hill cattle even after repeated parenteral administration of multiple doses of formalin killed cells. The culture could not be typed by serological and immunological methods with the 'factor' sera available in this laboratory against Robert's types I, II, III and IV and Hudson's type V of *P. septica* as well as *P. haemolytica.* Analysis by agar-diffusion precipitin method of Ouchterlony revealed the occurrence of three common antigens in this strain and the defined types of *P. septica,* which were, however, absent in *P. haemolytica.* The evidence from chemical extraction of type specific soluble antigen by two different procedures suggested the existence of a number of antigens determining type-specificity in the species, *P. septica.*

The role of *P. septica* as a human pathogen is discussed and it is suggested that, as this animal organism is being reported, rather frequently in human beings, further investigation is necessary to establish the avenue of infection and mode or modes of transmission.

62. Studies on the bacteriology of pneumonia in sheep and goats—I. Review of literature and results of a survey.

M. R. DHANDA and P. CHANDRA SEKHARIAH, Kumaon.

Pneumonia must be classed as one of the most important clinical syndromes in sheep and goats, both as an acute killing disease and in a more chronic form where loss is less apparent. Examination of 192 apparently healthy sheep slaughtered at the Madras abattoir revealed that as many as 38 (19·8%) showed definite lesions of pneumonia while the rate of incidence in goats was 57/228 (25·0%). At Mukteswar-Kumaon, in the course of 1725 consecutive post-mortem examinations of sheep carried out over a period of several years, 260 (15·0%) animals were found to show lesions of pneumonia while the incidence in goats was 157/625 (25·0%). As gleaned through the results of the present survey, there is evidence for the occurrence of three specific types of pneumonia : parasitic bronchopneumonia, enzootic pneumonia and Jaagsiekte. This is the first authentic record of chronic progressive pneumonia (Jaagsiekte) in India.

Studies on the bacterial flora of the pneumonic lungs of 250 sheep and 150 goats resulted in the isolation of a large variety of organisms, the most important of which were *Pasteurella septica, P. haemolytica, Klebsiella pneumoniae, Streptococcus pneumoniae* (types 3, 28 and 28A), *Erysipelothrix* (Listeria) *monocytogenes, Nocardia asteroides, N. sebivorans* and *Actinobacillus lignieresi.*

63. Studies on identical twins in Indian cattle—I. Selection and identification.

M. P. JOHARI, Mathura.

Two male and one female pair of cattle twins were identified as identical twins. The details regarding the different tests made and the methods of identification have been given. The usefulness of cattle twins for research and the possibility of obtaining such material in our Indian cattle has been indicated.

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64. Host-specificity of *Indochirus utkalensis* Kanungo and Biswal, 1958 (Listrophoridae : Acarina).

K. KANUNGO and BISWAL, Cuttack.

Experiments on transmission of a listrophoid mite *Indochirus utkalnesis* from guinea-pigs to rabbits and Swiss mice were conducted. Neither the rabbits nor Swiss mice could be infected with *I utkalensis* Host-specificity of *I. utkalensis* with reference to the rabbits and Swiss mice as hosts has been discussed and a contrast is drawn with many genera of the families Listrophoridae and Sarcoptidae.

Two probable reasons have been put forth to account for this host-specificity of *I. utkalensis*, one being the difference in the strength and stiffness of hairs between its natural host i.e. the guinea-pigs and the experimental hosts, i.e., rabbits and Swiss mice; the other being the sense-perception of the parasite to distinguish the skin and size of its natural host from that of rabbits and Swiss mice used in the experiment.

65. Hitherto unrecorded occurrence of a *Balantidium Sp.* (Ciliata : Protozoa) in diarrhoeic faeces of water-buffaloes in Orissa.

G. BISWAL and K KANUNGO, Cuttack.

A *Balantidium* sp associated with diarrhoea in water buffaloes and buffalo-calves is reported here for the first time Microscopic examination of faecal samples from such affected calves revealed an infestation of ascaridia as well as balantidia, the latter found in the last voided portion of faeces. Treatment with hetrazan eliminated ascarid infestation but not the balantidia or the diarrhoeic symptoms. As such it is presumed that hetrazan had no effect on the *Balantidium* sp. and the latter can prolong diarrhoea in buffalo-calves as a secondary factor.

Similarly, diarrhoeic faecal samples of adult buffaloes, on examination, revealed the infestation of liver-flukes and also balantidia. Treating these animals with Hexachlorethane diarrhoea subsided and such post-treated faecal samples showed no evidence of liver-flukes infestation nor balantidia. Hence it is inferred that Hexachlorethane had probably a static or lethal effect on the balantidia reported herein.

66. Chemical composition and nutritive value of cowpea *(Vigna catiang)* and the silage of shed-leaves of Jaman *(Enugenia jambolena).*

S. J. DANIEL, Izatnagar.

Jaman is a large tree and is distributed all over India. The leaves are shed in the beginning of summer season, and is usually allowed to go as waste.

22 maunds shed leaves of Jaman were ensiled with 96 maunds of cowpea (vigna catiang). The percentage composition of the silage (on dry matter basis) was found to be organic matter, 89·99; crude protein, 9·00; ether extract, 4·02; crude fibre, 38·49; nitrogen free extract, 38·48; total carbohydrate, 76·97; total ash; 10·01, calcium, (CaO) 2·30, and phosphorus, (P_2O_5) 0·32.

In order to investigate the nutritive value of the silage a digestibility trial was carried out on hill bullocks. The silage was fed *ad libtum.* The average digestibility coefficients were found to be organic matter, 24·49; crude protein 27·10; ether extract, 38·95; crude fibre, 33·60; nitrogen free-extract, 43·80, and total carbohydrates, 37·72. The values of digestible crude protein, total digestible nutrients and starch equivalent in lb. per 100 lb. of dry matter were found to be 2·42, 35-72 and 12.71, respectively. The experimental animals registered negative balances for nitrogen, calcium and phosphorus.

The results indicate that shed-leaves of Jaman may be utilized as cattle feed by ensiling them with green cowpea, and supplementing the silage with some concentrate feed which will make up the deficiency of nitrogen, calcium and phosphorous.

67. Effect of air temperature and humidity on the physiological reaction of different breeds of cattle.

B. S. KAUSHAL, D. N. MULLICK and N. D. KEHAR, Izatnagar.

16 Hariana breed heifers and 16 Bengal breed heifers of 9-11 months old were devided into 2 groups in each breed. Each group was maintained on isocaloric rations which were commonly fed to the animals in Punjab and Bengal. The experimental observations were made at Calcutta. Pulse rate, respiration rate and body temperatures were recorded weekly in the forenoon and afternoon. The atmospheric conditions were maintained.

The results showed that all the reactions were higher in the summer months than winter, respiration rate showed highest variation, next was body temperature and least was the pulse rate. All the values were higher in the afternoon. The reactions gradually declined with the advance of age but there were individual variations in all the reactions. Dietary treatments had no effect in these variations.

68. A new hide preservative (Part I).

S. C. NANDY and S. N. SEN, Madras.

Paludrine Proguanil hydrochloride (I.C.I. Ltd.), 1-(P-chlorophenyl)-5-isopropyl biguanide-HCl is well recognised for its antimalarial property. But its antimicrobial action is very little known. Paludrine in preliminary investigation has demonstrated considerable bacteriostatic action against a mixed culture containing both gram positive and gram negative organisms. Its application as a hide preservative has been tried out in leather industry. In the present work the antiseptic value of Paludrine has been tested during soaking of dried, dry-salted, and wet salted hides. A soak liquor containing 0·05 percent of Paludrine has been found to prevent bacterial growth and action during a period of 4 to 5 days, the hide and soak liquor ratio being 1 : 10. The proportion of Paludrine may be lowered in soaking wet salted and dry salted hides where such a long soak is not required.

69. Studies on *Clostridium welchii* isolated from suspected cases of infectious enterotoxaemia in sheep in India.

P. R. NILAKANTAN, B. K. KATHURIA and M. R. DHANDA, Kumaon.

Seventy three cultures of *Cl. welchii* isolated from material obtained from suspected cases of enterotoxaemia in sheep were studied. They were short, stumpy, red shaped organisms, measuring 2 to 3 x 1 micron, Gram positive, intensely stained and capsulated. Sporulation took place in alkaline egg medium. Surface colonies on blood agar plates were either small, round, low convex, translucent and 1 to 2 mm. in diameter or fairly large, greyish white, flat or umbonate with lobate margin and 3 to 4 mm. in diameter and were *beta* haemolytic. They fermented dextrose, lactose, maltose and sucrose but not mannitol. Salicin was fermented by only four of the cultures. All but three cultures produced 'stormy clot' in milk and all except two liquefied gelatin. They were pathogenic to guinea-pigs, mice and pigeons producing typical gas gangrene and death.

Of the 73 isolates only 43 produced demonstrable toxins in culture and 30 were nontoxigenic. Of the 43 toxigenic strains 31 were Type A producing only *alpha* toxin and 12 were Type D producing both *alpha* and *epsilon* toxins. Presence of *alpha* and *epsilon* toxins in the intestinal contents was demonstrated only in six of 12 cases from which *Cl. welchii* Type D was isolated. It was observed that toxins of *Cl. welchii* were not demonstrable unless intestinal contents from suspected cases were collected soon after death of animals and were properly preserved and stored prior to laboratory examination. Further, some of the Type D strains easily lost the property of producing either *epsilon* or both *epsilon* and *alpha* toxins during storage in laboratory, thereby, giving the impression of transformation into Type A or becoming nontoxigenic.

70. Observations on the effect of immunization of fowls with different vaccine strains of Newcastle (Ranikhet) disease virus.

P. R. NILAKANTAN, P. SAKKUBAI and M. R. DHANDA, Kumaon.

The four vaccine strains of Newcastle disease virus (NDV) used in this study were (i) Mukteswar (R_2B), (ii) Palestine, (iii) American 'B_1' and (iv) British 'F'. Groups of fowls were immunized by administering the vaccines by different routes, namely, intramuscular, intradermal (prick method), intranasal, conjunctival and oral (in drinking water) and the immunity response was compared by determining at weekly intervals haemagglutinin inhibiting (HI) titre of sera of the birds.

Mukteswar and Palestine strains :—Birds immunized with these strains revealed high antibody response irrespective of the route of vaccination. HI titres of their sera rose to 1 :1446 and 1 :537 respectively in seven days, reaching a maximum of about 1 :14080 in two to three weeks and later there was a decline. Though HI antibodies could be detected only from fifth day after vaccination yet birds withstood challenge infection with virulent NDV even after 72 hours. Birds proved to be solidly immune when challenged about eight months after vaccination and HI titres of their sera were 1 :853 and 1 :320 respectively.

American 'B_1' and British 'F' strains :—Birds immunized with these strains revealed only a low grade antibody response irrespective of the route of vaccination. However, intranasal and oral routes evoked slightly better antibody response than the intramuscular route. Very little rise in HI titre was noticed on seventh day after vaccination (1 :25) a maximum of about 1 :1150 being obtained in three to four weeks. Protection was found to be established 5 days after vaccination. The immunity was lasting for a period of at least two months but birds challenged eight months after immunization all died.

71. Variations in the protein fractions of blood plasma of fowls immunized with different strains of Newcastle (Ranikhet) disease virus.

P. R. NILAKANTAN, S. S. NEGI and M. R. DHANDA, Kumaun.

Mukteswar (R_2B), Palestine, American 'B_1' and British 'F' strains of Newcastle disease virus were used to immunize groups of ten fowls each and protein fractions of blood plasma of these birds were estimated at weekly intervals.

In the case of birds immunized with Mukteswar and Palestine strains, definite rise in the plasma protein level due to rise in the globulin fractions (euglobulin, pseudoglobulin I and pseudoglobulin II) was noticed one week after immunization followed by a decrease during the subsequent two weeks. However, haemagglutinin inhibiting antibody titre of sera of the birds showed a marked rise during the first and subsequent two weeks after vaccination.

Practically no change in plasma protein levels was observed in the case of birds immunized with American 'B$_1$' and British 'F' strains during the Four-week period of observation, while the haemagglutinin inhibiting antibody titre of sera showed a low grade increase during the first and subsequent three weeks after immunization.

72. Studies on blackquarter. I.—Etiology.

P. R. NILAKANTAN and M. R. DHANDA, Kumaun.

One hundred and eightyeight cultures of anaerobes isolated from cases of blackquarter in cattle, buffaloes, sheep and goats were studied and typed. Of the 179 cultures obtained from cattle and buffaloes 161 (90%) proved to be *Cl. chauvoei*, 9 (5%) *Cl. septicum*, 5 (2·8%) *Cl. welchii* and 4 (2·2%) mixtures of *Cl. chauvoei* and *Cl. septicum*.

Typing of cultures was done on the basis of (i) morphological and staining characters, (ii) cultural characters in cooked meat medium, blood agar plates and cysteine agar shake cultures, (iii) biochemical reactions viz. action on litmus milk, and gelatin, fermentation of carbohydrates like dextrose, lactose, maltose, sucrose, mannitol and salicin and haemolysis of sheep red blood cells, and (iv) pathogenicity to guinea pigs.

A basal medium comprising 2% peptone, 0·5% sodium chloride, 0·1% each of ferric sulphate, sodium citrate, magnesium sulphate and sodium thioglycollate and 10% ox serum was found to be satisfactory for studying sugar fermentation reactions of *Cl. chauvoei*.

It was seen that whenever material from fresh cases of blackquarter in cattle collected during life or soon after death was subjected to a bacteriological examination, it invariably resulted in the isolation of *Cl. chauvoei* while in material collected from carcases after a lapse of 15 to 24 hours, *Cl. septicum* and *C. welchii* were isolated alone or in association with *Cl. chauvoei*.

It was also observed that *Cl. septicum* and *Cl. welchii* could be isolated from heart blood and muscles of guinea pigs which died following artificial infection with pure *Cl. chauvoei* if the carcasses were kept for 24 to 72 hours at 18 to 20°C and 12 to 20 hours at 30°C. On the basis of these findings it was concluded that *Cl. chauvoei* was the true cause of blackquarter in cattle in India and that the occurrence of *Cl. septicum* and *Cl. welchii* was only incidental, their presence being as post-mortem contaminants.

Of the 9 cultures isolated from sheep and goats suspected to be cases of blackquarter 8 were typed as *Cl.septicum* and one *Cl. welchii*.

SECTION OF AGRICULTURAL SCIENCES

President :—Dr. B. K. Kar, M.Sc., Ph.D., F.B.S.

Abstracts

PLANT BREEDING AND GENETICS

1. Genetic studies in Rice.

S. SAMPATH and D. V. SESHU, Cuttack.

From a hybrid between two varieties of *Oryza glaberrima,* which differed in the length of sterile lemma (glume) it was observed that shortness was dominant over long, and one pair of alleles controlled the difference. This is parallel to the genetic condition recorded in *Oryza sativa,* and brings out the similarity between the two species.

From a hybrid between photoperiod insensitive (early) glutinous (waxy) *japonica* variety and a photoperiod sensitive (late) starchy *indica* variety, insensitivity was observed to be dominant, cumulative duplicate allelic pairs being involved. These duplicate factors showed independant segregation, but one of them showed linkage to the gene pair controlling starch development. Using the minimum discrepancy method this linkage with one of the duplicate genes was found to be very tight with repulsion.

2. Semisterility in Tetraploid Rices.

S. SAMPATH and D. V. SESHU, Cuttack.

Four homozygous and four heterozygous types of tetraploid rice produced by colchicine treatment of pure strains and F_1 hybrids respectively were used in an experiment to determine the effect of environmental factors on spikelet sterility. In a small scale experiment three treatments were given to these plants during and after flower initiation, namely, (a) spraying with 1 : 1000 borax solution, (b) spraying as above combined with intensive manuring in the form of pellets (Ammophos) placed below the plants, (c) intensive manuring alone, as above, and (d) control which was untreated. Intensive manuring with placed pellets of Ammophos, consistently reduced spikelet sterility in the samples studied. Borax spraying alone (without manure) tended to increase sterility in some cases but the difference is not considered significant. A combined treatment of manure and borax spraying was found to be inferior to manuring alone in reducing spikelet sterility. The present trial indicates that seed setting is also controlled by physiological factors apart from genic and chromosomal causes

3. Utilization of Male Sterility for Hybrid Maize Seed Production without Detasseling.

B. SEN and H. C. JOSHI, Almora.

Cytoplasmic male sterile lines of maize of K. 4 and Kys. were received from Dr. Donald Jones of Connecticut and Tx 203 m.s. from Dr. Robert of Texas for exploring the proper technique for the production of hybrid maize seeds without detasseling in India. Work on these has been in progress in this Laboratory since 1950.

One of the most expensive and necessary operation in the production of double cross hybrid maize seeds is the detasseling of the single cross seed parents in the seed production field.

By incorporating cytoplasmic male sterility in different inbred lines Dr. Jones has shown in 1949 that the double cross hybrid seeds produced without detasseling are just as good, if not better, than the seeds produced by the usual detasseling method.

There are inbred lines which when crossed with cytoplasmic male sterile lines produce 100% sterile single-crosses and others which produce 100% fertile single-crosses. For production of hybrid maize seeds without detasseling we need both these types of single-crosses. The sterile single-crosses are to be used for seed parent so that no detasseling would be necessary and for the pollinator we must have fertile single-cross. It has been found by Edwardson (1955) that if only one restorer inbred is used for pollen parent single-cross the resulting double cross seeds produced without detasseling will produce plants only 50% of which will have functional pollen. On the other hand, if both the inbreds are restorers then the double cross seeds would produce 100% tassel fertile plants. But for the production of these single cross seeds bagging or detasseling in isolated plots will have to be done.

Since we have found that the crosses between male-sterile and male-fertile inbred lines which were male-fertile or partially fertile at Almora were completely sterile at New Delhi, it is necessary to utilise two restorer inbreds for pollen parents, and for producing the single cross seeds for sowing an acre of double cross seed production plot only 20 to 25 controlled pollination or detasseling for production of single cross need be done. While without the use of cytoplasmic male sterile lines, production of 1 acre plot would require detasseling of 16435 plants.

Five double cross hybrids--VL D-1, 2, 3, 4 and 5 were produced without detasseling in 1955 Two trials with these hybrids were undertaken at Almora in 1956 and one trial in 1957. These hybrids were also tried at the Indian Agricultural Research Institute, New Delhi in 1956. The results indicate that in Almora trials the yields of the double crosses were similar to those of the standard hybrids like U.S.13 and in Delhi VL D-2 and D-5 were similar to Tx.26.

4. Studies on the effects of different growth regulators in overcoming cross-incompatibility between *Brassica juncea* Hook f. & Thoms. and *B. napus* Linn. and self-incompatibility in *B. napus* Linn.

S. L. BASAK and R. M. DATTA, Calcutta.

By the use of two growth regulators (IAA and NAA) both self- and cross-incompatibility barriers in *B. napus* and *B juncea* are found to be overcome. The results have indicated that it is possible to accelerate the rates of pollentube growth in these two species by the application of suitable concentrations of these two hormones. By application of suitable concentrations a large amount of pod and normal seed setting in selfed *B. napus* has been recorded. The production of pods and normal seeds in reciprocal interspecific crosses between these two *Brassica* species can be appreciably increased as a result of spraying of IAA and NAA in suitable concentrations at the time of cross pollination.

In spite of our results being positive, further work is necessary and will be repeated next season. These chemicals induced a large number of ovules being fertilized and stimulated growth, development and enlargement of the embryos, endosperm as well as the ovarian tissues. Thus, healthy seeds and pods were formed.

Cytological studies reveal the occurrence of pseudo-embryony (nucellar) in control in both reciprocal crosses along with infrequent occurrence of this phenomenon (pseudo-embryony) at 1 ppm. IAA and 1 ppm. NAA in *B. juncea* ♀ × *B. napus* ♂. The incidence of viviparous germination of normal seeds in both types of crosses, induced by the application of these growth substances, is reported for the first time.

5. Interspecific hybridization between *Corchorus olitorius* Linn. (Strain C.G.) and *C. sidoides* F. Muell, a Wild jute of Australia, and *C. capsularis* Linn. (Strain D154) and *C. sidoides* F. Muell.

S. K. DANA and R. M. DATTA, Calcutta.

In *C. olitorius* ♀ × *C. sidoides* ♂, the pod set was 29·4% and the percentage of pod harvested (out of the set pods) was 20%. All the harvested pods were empty.

In *C. sidoides* ♀ × *C. olitorius* ♂, the pod set was 26·8% and out of the set pods 9·0% pods were harvested. The single harvested pod yielded the following types of seeds—4 empty, 9 partially full and 4 apparently normal—looking full seeds. The so-called normal looking seeds were underweighted, when compared to the same number of seeds of the mother plant. The average number of ovules per pod in *C. capsularis*, *C. olitorius* and *C. sidoides* are 50,200 and 55 respectively. Number of seeds per gramme in *C. capsularis*, *C. olitorius* and *C. sidoides* are 300, 500 and 1,893 respectively. The cause of interspecific incompatibility is discussed.

The results obtained in these experiments are more or less similar with the findings of one of us (R.M.D.) recorded during 1953-1955, who studied the subject extensively and intensively.

This experiment was taken up in 1957 in the hope of getting a hybrid, if any, which can be profitably utilized in bridge-crossing with the other economic *Corchorus* species

6. Studies on the effects of growth substances on the interspecific incompatibility in the cultivated jute species (*Corchorus olitorius* Linn. and *C. capsularis* Linn.)

P. DAS GUPTA and R. M. DATTA, Calcutta.

The three hormones, viz., Indole-acetic acid, Indole-butyric acid and Napthalene acetic acid with their respective optimal concentrations for pollentube growth and germination in these two cultivated jute species (Strains :—C.G. and D154) were utilized in the actual interspecific hybridization programme to overcome the existing incompatibility barrier.

In both types of crosses (C.G. × D154 and D154 × C.G.) only NAA (10 ppm.) has a definite stimulating effect on the fertilization phenomenon. Fertilization was observed within one day, which was faster than that in case of untreated cross pollination, as previously observed by one of us (R.M.D.) in 1954. Endosperm development was also very prominent within 2-3 days. It was faster than that in the self-pollination as well as in the cross-pollination. This hormone, however, did not stimulate longer and as a result, some of the cross pods failed to reach maturity. Besides, the rest of cross pods could not be harvested due to severe attack by *Apion corchori*.

Although indole-acetic acid stimulated at the earlier stages of ovule development, it soon caused degeneration and collapse of ovules of both crossed materials within three days.

Indole-butyric acid had a more adverse effect. Marked shrivelling and degeneration of ovules were due to this treatment. Further studies are in progress.

7. Preliminary studies on the interspecific hybridization between the autotetraploids of the cultivated jute species— *Corchorus olitorius* Linn. (Strain C.G.) and C. capsularis Linn. (Strain D154) and the Cytogenetical basis of incompatibility between them.

R. M. DATTA and S. K. DANA, Calcutta.

Both *C. olitorius* and *C. capsularis* are cross-incompatible at the 2n level. In order to combine them at the 4n level colchiploids were raised both in the cultivated and the wild states. They were hybridized for three successive years by one of us (R.M.D.) (1954-1956) but no amphidiploids could be raised. In 1957 the hybridization experiments were repeated. In both types of crosses (4n C.G. ♀ × 4n D154 ♂ and 4n D154 ♀ × 4n C.G. ♂) pods were found to set but all of them shed before reaching maturity. On the cytogenetical studies it was observed that only a few uppermost ovules were found to be fertilized. The pollentubes were seen to reach the ovules within 24 hours. In 4n D154 ♀ × 4n C.G. ♂, the fusion of sperms with the egg or with the polars were not complete till 2 days. In 4n C.G. ♀ × 4n D154 ♂ these processes of fusion went on till 2 days but sometimes they were found to be complete even within 24 hours. In both these cases degeneration of the ovules set in within 2 days and no viable seeds could be obtained. Bhaduri and Chakravorti (1948) claimed to have raised amphidiploids in the cultivated jute species. Our findings do not support their claim. Further studies are in progress.

8. Preliminary observations on few intergeneric crosses in the family Pedaliaceae.

N. R. PANIGRAHI and R. N. MOHANTY, Bhubaneswar.

Inter-generic crosses with *Sesamum orientale* × *Martynia annua* and its reciprocal, and *Pedalium murex* with *Sesamum orientale* were made. A selfed Sesamum plant was taken for comparison as regards the percentage of pollen germination and rate of pollen tube growth in these crosses. The female plants were emasculated the previous evening and crossing was done next morning. The flowers after pollination were collected after 1 hour of pollination and subsequently at an interval of 2 hours. The style and stigma were stained in 1% cotton clue, and examined The observations indicated that in the cross between Sesamum and Martynia involving the former as the female parent the pollen grains germinated well and by 24 hours the pollen tube reached the ovary. In some flowers allowed to set seed, it was observed, after about 20 days of crossing, that the ovaries remained green but did not grow further. In the reciprocal cross the pollen tube growth was slow, and by 24 hours it could hardly traverse ⅛ of the stylar length. After 3 days of pollination the ovary with style and stigma fell down. The cross with *Pedalium* × *murex*, taking it as the female parent showed that the pollen germination was poor and even after 24 hours there was not much growth of the pollen tube. The stylar lengths of Martynia, Pedalium and Sesamum were measured which were (2·7 cm., 1·1 cm., and 1·3 cm.) respectively. It is supposed that the greater stylar length in Martynia perhaps precludes the pollen tube from reaching the ovary in this cross. More intensive work in this line is being continued at this Research Station.

AGRONOMY

9. Time of application of Nitrogen to Rice Crop.

B. N. SAHU and I. C. MAHAPATRA, Orissa.

To determine the optimum time of application of nitrogen to rice crop either in single or split doses in the form of sulphate of ammonia and urea, field experiments were conducted with seven combinations of time of applications (before planting (E), at planting (P), at tillering (T), ET, PT, ETF and PTF (F. application of fertiliser one week before flowering) X 2 types of nitrogen (urea and ammonium sulphate) + one control in randomised block design in three replications of 15 treatments each, for two seasons (1956-57) and (1957-58) in the Agronomy Section of the State Agricultural Research Station, Bhubaneswar, Orissa. Nitrogen was applied at the rate of 40 lbs. per acre according to the various times of application with a basal dressing of 5,000 lbs. of Farm-yard-manure and 20 lbs. of P_2O_5 in the form of single superphosphate. A long duration variety of paddy, T1242, (160 days) was grown in the experiment.

The results indicate that yield differences among the various treatments are not statistically significant. The non-significance of yield data between the N- treated and control plots is due to the fact that nitrogen requirement of rice crop has probably been met by 5,000 lbs. of Farm-yard-manure which was applied as a basal dressing to all the plots uniformally. The yield data further reveal that there is no difference in yield due to sulphate of ammonia and urea. The interaction between forms of nitrogen and time of application is however, statistically significant.

Urea, a concentrated, potentially lower priced nitrogenous fertiliser can be used as alternate source of nitrogen to sulphate of ammonia, the effects of both the fertilisers being identical on the yield of grain. Ammonium Sulphate when applied in single dose should be incorporated into the soil at or before the final puddling operation. When the split application is desired the times of application should coincide with planting, tillering and flowering stages of the crop. Urea should not be applied earlier than tillering stage to the rice crop under Bhubaneswar condition.

10. Preliminary studies on the effect of manuring on roselle (*Hibiscus sabdariffa* L.)

A. N. DATTA and B. C. KUNDU, Barrackpore.

A manurial trial on roselle (*Hibiscus sabdariffa* L.) was conducted in replicated randomized blocks with 4 replications in 1956 at Nilganj, Barrackpore to study the effect on the yield of fibre of roselle (R.T. 2) due to different kinds of manures and fertilizers applied at varying levels. The treatments were nitrogen at 3 levels in the form of ammonium sulphate, viz., N_0 (No nitrogen), N_1 (40 lbs. of nitrogen per acre) and N_2 (80 lbs. of nitrogen per acre); P_2O_5 and K_2O each at two levels in the form of superphosphate and muriate of potash respectively viz., P_0 (No P_2O_5), P_1 (40 lbs. of P_2O_5 per acre); K_0 (No K_2O), K_1 (25 lbs. of K_2O per acre) thus making twelve treatment combinations plus two doses of compost, i.e., C_1 and C_2 at the rate of 40 lbs. and 80 lbs. of N per acre respectively and a highest dose of nitrogen i.e., N_3 (120 lbs. of nitrogen per acre)—giving 15 treatments in all. All the manures and fertilizers except ammonium sulphate were applied in one instalment before sowing while the ammonium sulphate was applied in three instalments, viz., 50% before sowing and the rest 50% in two equal instalments as topdressing after six weeks and twelve weeks from sowing.

The seeds were sown broadcast. The intercultural operation consisted of weeding and mulching and the crop was harvested at the early-pod stage for the extraction of fibres. Data on fibre yield were recorded which were subjected to statistical analysis.

The differences of yield of fibre due to various manurial treatments are significant at 1 per cent level of probability. The manurial treatment N_3 (nitrogen at the rate of 120 lbs. per acre) has given the highest yield of fibre (23·67 mds. per acre) yielding about 45% higher yields than the control (No manure). The fibre yield records, indicate that nitrogen has got an appreciable effect on the increase of yield of fibre of roselle as higher yields are obtained with higher doses of nitrogen and the fibre yields are decreased with lower doses of nitrogen lowest being obtained in the manurial treatments without nitrogen.

The results also indicate that potash and phosphate have no considerable effect on the yield of fibre either applied singly or in combination of these two elements without nitrogen. Potash and phosphate, however, in combination with higher doses of nitrogen give good response on the increase of yield of fibre.

The present study, though of preliminary nature, tentatively indicates that high doses of nitrogen are essential for better yield of fibre of roselle. The experiment is, however, being continued for further detailed investigations.

11. Preliminary studies on the direction of sowing with fertilizer on the yield of jute fibre *(Corchorus Capsularis)*.

B. K. DAS, D. B. DUA, S. N. MITRA and A. SARKAR, Barrackpore.

A preliminary study on yield of jute fibre was made at the Jute Agricultural Research Institute Farm, Nilganj, Barrackpore to compare ammonium sulphate and ammonium chloride and to observe their behaviour when jute sown in rows of different directions. The trial was conducted in a split plot layout with 4 replications, the fertilizer being in the main plot and the direction of sowing in the sub-plot. The whole plot treatments consisted of 6 types of fertilizers : ((i) Ammon. Sulphate (40 lb. N) and Pot. Chloride (25 lb. K_2O), (ii) Ammon. Sulphate (40 lb. N) and Pot. Chloride (50 lb. K_2O), (iii) Ammon. Chloride (40 lb. N) and Pot. Chloride (25 K_2O), (iv) Ammon. Chloride (40 lb. N) and Pot. Chloride (50 lb. K_2O), (v) Ammon. Sulphate (40 lb. N) and (vi) Ammon. Chloride (40 lb. N) and the sub-plot treatments consisted of 2 directions of sowing : (i) East-West and (ii) North-South. One foot non-experimental margin all round each plot was maintained making the effective plot size 18′ x 20′. The crop was harvested at usual small pod stage of maturity and necessary records of green weight, stand, fibre yield per plot were maintained.

From analysis of the yield data no significant differences were observed between the two direction of sowings. Amongst the fertilizers tried also none gave any advantage over the other, Ammonium sulphate either alone or in combination with potassium chloride did not prove significantly superior to ammonium chloride either alone or together with potash.

12. Preliminary observations on the effect of sowing dates on yield of jute seed *(Corchorus olitorius)*.

B. K. DAS, D. B. DUA, S. N. MITRA and A. SARKAR, Barrackpore.

In a preliminary observation the effect of different dates of sowing on yield of jute seed was studied with *Corchorus olitorius* in 1956-57 in a simple randomized block layout with 4 replications at the Jute Agricultural Research Institute Farm at Nilganj, Barrackpore. The variety used was JRO-632. The treatments included six different dates, beginning from 18th May at an interval of 15 days.

From analysis of data, it was found that the effect due to date of sowing was significant at 5% level. Amongst the dates of sowing, 2nd June sowing gave the highest yield (4·02 md./acre) closely followed by 2nd July (3·99 md./acre), 17th June (3·92 md./acre) and 18th May (3·87 md./acre) all being in the same critical group. The first two above sowings were significantly superior to 17th July and 1st August sowings. It was therefore observed during the year, that for seed production the sowing of olitorius jute (JRO-632) under Nilganj conditions can be conveniently delayed up to beginning of July; any sowing done earlier does not give any real extra advantage.

13. Effect of varying depths of cultivation with various doses of manures and their methods of application of the yield of cotton.

A. R. KHAN and K. K. MURTHY, New Delhi.

An investigation to find the effect of variation in depth of ploughing by tractor implements (9"-10"); bullock implements consisting of 'Victory' (5"-6") followed by 'Country' and 'country' (4"-5") alone, with 'Placement' and 'Broadcast' application of 40 lb. N. in the forms of ammonium sulphate and groundnut cake singly and each with an additional dose of 80 lb. P_2O_5 as super, on the yield of cotton was conducted at I.A.R.I., during 1957-58. A summaary of important results follows:

All the tillage treatments gave lesser percentage of 7 mm. and above clods as compared to pre-tillage conditions of the soil. Soil inversion resulted in higher percentage of bigger clods as compared to non-inversion. Country plough not only gave the highest percentage of 2-7 mm. clods, but also of 0·5-3 mm. water stable aggregates and thus resulted in best tilth. Other physical properties were not affected by tillage treatments appreciably. A close relationship between 0·5-3 mm. aggregates, total pore space, moisture equivalent and final yield was however, observed. Soil analysis at harvest revealed general deterioration in aggregates and pore space.

A close relationship between fruiting coefficient, total nitrogen in the final dry matter and yield, due to tillage treatments was observed. The fruiting coefficient and total nitrogen were significantly affected by 'Country'. So was the earliness of crop as seen by Bartlett's index. 'Country' gave least fibre weight while 'Victory' gave the highest. Placement of manures in combination with 'Country' significantly increased the yield. Placement at plough sole as against broadcast of manures resulted in significantly higher yield. This method was also found to be economical. Placement favoured fibre length while broadcast favoured fibre fineness.

14. Studies on the interrelationship of cultivation treatments, levels of nitrogen and irrigation interval on sugarcane.

A. R. KHAN and B. MANDAL, I.A.R.I., New Delhi

To study the effects of three depths of preparatory tillage ($C_0=4''$ with country plough, $C_1=6''$ and $C_2=10''$ with tractor plough) in combination with three doses of nitrogen ($N_1=80$ lb., $N_2=120$ lb., $N_3=160$ lb. N/acre) and three intervals of irrigation ($I_1=10$ days', $I_2=15$ days and $I_3=20$ days') on the growth, yield and quality of sugarcane crop, an experiment was conducted at I.A.R.I. Farm during 1957-58, is a split plot design taking tillage treatments in main plots and combination of nitrogen and irrigation treatments in subplots.

Soil studies revealed better aggregation with deeper tillage, but its effect on growth characters was not significant. Higher doses of nitrogen and shorter intervals of irrigation increased the number of millable stalks and cane height significantly upto the optimum dose of 120 lb. nitrogen and 15 days' of irrigation interval. During active growth phase the percentage of leaf nitrogen on dry weight was 1·685 and 1·568 and the percentage of sheath moisture on green weight was 84·00 and 85·33 for 3rd (June) and 5th (August) months respectively under the optimum levels of nitrogen and irrigation. Shallower tillage, higher doses of nitrogen and shorter intervals of irrigation favoured surface rooting, whereas deeper tillage and deficient irrigation promoted deep rooting. The cane quality remained unaffected by any of the treatments. The increased yields of cane and sugar by deeper tillage were not significant over those of shallow tillage. The yields increased significantly upto 120 lb. N and 15 days' interval of irrigation. The response curves, both of N and irrigation, showed quadratic relationship. In correlation studies it was established that stalk population made primary contribution towards yield, whereas cane height offered only subordinate influence.

15. Effects of various rotations on the Cotton Crop.

SHRI C. B. DIVEKAR and SHRI F. B. KURTKOTI, Dharwar.

Synopsis :

Crop sequence is a recognised Agronomic practice. In Karnatak Cotton and Jowar forms the normal rotation. The possibility of introducing groundnut in a two-way and three-way rotation with cotton, under rainfed conditions of Dharwar has been investigated. Cotton *Var.* Jayadhar (Gossypium herbaceum), Jowar *Var.* Nandyal and Groundnut *Var.* Spanish—improved were grown as components of rotation in the present study

It is observed that :

The cotton yields in continuous cotton, manured with farm-yard manure either every year in alternate years are lower than the normal yields by 4·95% and 11·27% respectively.

Groundnut can be rotated with cotton without detriment to the cotton yields and also appears to avoid ill effects of Jowar on Cotton and at the same time saves farmyard manure required to be applied to Jowar in the normal Jowar-Cotton rotation.

Application of farm-yard manure to cotton in Groundnut- cotton rotation gives 19·36% more yield of Seed Cotton with the same expenditure of manure as in the normal rotation.

In a three-way rotation of Groundnut- Cotton-Jowar, the cotton yields are higher by 32·01%, when Cotton succeeds groundnut, as compared to the normal cotton yields. However, Jowar preceeding cotton is found to be detrimental to cotton yields even though groundnut is included in the rotation.

16. An experimental investigation of the dual use of Paddy Fields : Mixed Rice Cultivation and Fish Culture.

B. C. DAS, Calcutta.

An experimental investigation was taken up to investigate the feasibility of mixed rice cultivation and fish culture in paddy fields, with particular reference to the effect of fish on paddy and the effect of paddy on fish. In order to obtain the necessary data, an experiment was carried out (in Giridih, Bihar) using three treatments : paddy alone, fish alone and fish with paddy. A randomized block design was adopted for the experiment, with the three treatments represented in each of three blocks. Paddy seeds, of the water resistant variety 498-2A, were sown on the nursery seed bed at the rate of one pound per 100 square feet, and were transplanted to the main paddy fields when they were 7-9" in height. They were planted three to a hill, 10" each way between hills. Indian carp fingerlings (*Catla catla, Labeo rohita,* and *Cirrhina* mrigala) were introduced into the fields one month after the paddy had been transplanted, at the rate of 2,000 per acre. Three months after the fish were introduced, the paddy was harvested and the fish were collected. The following data were recorded : for paddy, the yield of wet and dry paddy, and dry straw, and for fish the initial number and number surviving, and the average initial and final weight. In this study, the fish enhanced the yield of paddy. Fields of paddy with fish had a yield of dry paddy 24·95% greater than the fields of paddy without fish. For dry straw, the corresponding increase was 28·41%. The fish fared better in fields without paddy than in fields with paddy, both in terms of increase in weight and percentage surviving. On the basis of actual costs, the net return per acre was Rs. 38·00 for fish alone, Rs. 195·00 for paddy alone, and Rs. 270·00 for paddy and fish combined.

17. Bulb size and seed yield in Onion *(Allium cepa L.)*

S. SOLOMON and J. A. Patil, Bombay.

An experiment to study the effect of size of mother bulb on onion seed production was undertaken at the Agricultural Research Station, Niphad (District Nasik), and run for a period of three years from 1954-55 to 1956-57.

The onions were grouped on bulb weight basis into five classes. Randomised block design layout was used. (The site of the experiment and the randomization of treatments were changed every year)

The pooled analysis of the 3 year's data showed that there was high significant differences in seed yield obtained from different sized mother bulbs. The interaction between different sized mother bulbs and season was also highly sifinificant, indicating a differential behaviour of different sized bulbs in the three seasons. The seed yield increased with increase in size of mother bulbs, in each year and on an average as well seed yields obtained from mother bulbs weighing 1 to 20 and 21 to 40 grams were significantly lower than those obtained from bulbs weighing 81 to 100 grams. There was no significant difference in seed yields obtained from mother bulbs weighing 41 to 60 grams. Hence it is, advantageous to use mother bulbs weighing not less than 40 grams for planting for seed purposes.

The number of seed stalks significantly increased with increase in size of mother bulbs in each year, as well as the number of seeds per main seed head. Small sized bulbs rotted more while more sprouting was observed in case of large sized onions. Though there was no significant difference in loss in weight during storage, smaller sized onion lost more in weight as compared to bigger sized onions.

The studies have indicated that the optimum size of mother bulbs for seed would be bulbs weighing more than 40 grams, as it is rather difficult to get very big-sized mother bulbs in sufficient number for planting for seed purposes.

18. Cultural trial on Groundnut *(Arachis hypogaea. L.)*

N. R. PANIGRAHI and R. N. MOHANTY, Bhubaneswar.

A cultural trial on Groundnut was undertaken with a view to finding out the best method of sowing Groundnut and the subsequent cultural operations to follow it.

The experiment was laid out with three treatments i.e. (a) sowing on flat bed and without any ridging later on (b) sowing on ridges (c) sowing on flat bed and later converted to ridges and providing for six replications. The observations on the yield of crop from each plot was recorded and the yield figures statistically analysed. It was observed that the yield from the treatment (a) i.e. sown on flat bed, gave significantly higher yield than the other two treatments, thereby sowing that planting on ridge or the ridging operation given later to a crop sown on flat bed did not prove remunerative from the yield point of view. It would therefore be more economical to grow the crop on flat bed only and avoid the unnecessary expenditure of ridging the crop. One of the possible causes of higher yield in case of flat bed sown crop may be that the ridging operation might be injuring the elongating gynophore and thus preventing pod formation. Interference of ridging on flowering at the lower nodes of groundnut plant may be another cause for reduced yield in the ridged crop.

PLANT PHYSIOLOGY

19. Heat-treatment of Maize (Zea mays) seeds and reversal of sex in the subsequent plants.

T. A. DAVIS*, Coimbatore.

This paper deals mainly with the phenomenon of reversal of the staminate flowers (tassel-flowers) on *Zea mays* into the pistillate ones. Opinion is divided on the causes that bring in reversal of sex in plants. While one group of Biologists is of opinion that sex is hereditary and therefore determined either by genes or specific chromosomes,, others believe that sex is physiological and dependent upon environmental factors. Short photo-period and mutilation of the shoot have great influence on the sex of some plants. In the course of an experiment, it was found that pre-sowing heat treatment of seeds of *Zea mays* induced sex reversal of tassel flowers in the subsequent plants. While in the terminal panicles of maize the stamens are fully developed and the carpels reduced to rudiments, the reverse is the case in the lateral spikes. The change of a functionally staminate flowers in the tassel into a functionally carpellate one is merely due to suppression of the male and stimulation of the carpellate initials. Reversal of sex, therefore, may be simply a process of stimulation of certain potentialities that are usually dormant and of suppression of other characters normally functioning. The grains collected from the normal ears and tassel-ears of these abnormal plants were sown and the plants failed to exhibit any reversal of sex.

20. Inducing Chlorophyll deficiency in Maize and Rice seedlings.

T. A. DAVIS†, Coimbatore.

External stimulations such as Atomic radiations, Ultra violet rays, X-rays, Temperature, Light etc. induce chlorophyll deficiency in plants. In the course of an experiment (Presowing heat treatment on some cereals) albinos or chlorophyll deficient seedlings in *Oryza sativa* and *Zea mays* were met with. The maximum percentage of these abberants were recorded from seeds subjected to a temperature of 80° C for one hour and two hours for maize and rice respectively. In both the cases, chlorophyll deficiency was manifested from the very first leaf onwards. While in rice the entire leaf was devoid of chlorophyll, the deficiency in maize manifested only in streaks. Production of further leaves of rice was very much retarded resulting the death of the abnormal seedlings after producing a couple of further reduced leaves. However, the chlorophyll deficient maize seedlings were not lethal. The degree of etiolation starting with the first leaf in this case attained its maximum at about the sixth leaf, which looked perfectly white. From the next leaf onwards, green streaks re-appeared and the seedlings regained normalcy after producing a few more leaves. These plants produced grains and fodder comparable with normal plants. This phenomenon of chlorophyll deficiency does not appear to be a heritable factor as evidenced by further trials.

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†Now at the Central Coconut Research Station, Kayangulam, Kerala.

21. Magnesium-Phosphorus-Crude Fat Interrelationships in the Seed of Pearl Millet (*Pennisetum typhoideum*-Rich.)

H. C. SHAH and B. V. MEHTA, Anand.

Ninety-six samples of Pearl millet seed each of the three seasons, monsoon 1956, summer 1957, and monsoon 1957, grown on *goradu* soil of Charotar tract of Kaira District in Bombay State, fertilized with ammonium chloride, ammonium sulphate, ammonium sulphate-nitrate, ammonium nitrate, urea, groundnut cake and farm-yard manure, were analysed for magnesium, phosphorus, and crude fat contents and their interrelationships were worked out using regression analysis. Calcium and potassium contents were also determined.

It was observed that calcium and magnesium in the seed of Pearl millet were inversely related and magnesium was present in amouts higher than those of calcium. It was also observed that, of the three mineral elements viz., magnesium, phosphorus and potassium, believed to be associated with the formation of fat in plants, only magnesium was found to have a direct and significant role in the crude fat formation, while phosphorus and potassium were found to have no direct role in the oil formation. The percentage of crude fat was higher with higher magnesium contents and lower with lower magnesium contents.

Ammonium chloride gave higher amounts of both magnesium and crude fat compared to ammonium sulphate, ammonium sulphate-nitrate, ammonium nitrate, urea, groundnut cake and farm-yard manure.

22. Comparative studies on the effect of Ammonium Chloride and other fertilizers on the yield and crude protein content of pearl millet (*Pennisetum typhoideum*-Rich.)—Part I.

H. C. SHAH and B. V. MEHTA, Anand.

With a view to study the suitability of ammonium chloride as a fertilizer for Pearl millet (*Pennisetum typhoideum*-Rich.) grown on sandy loam soil popularly known as *goradu* soil, field-experiments were conducted at the Institute of Agriculture, Anand (B.S.) over a 2-year period covering 3 crop seasons. For comparison, ammonium sulphate, ammonium sulphate-nitrate, ammonium nitrate, urea, groundnut cake and farm-yard manure were also included in the study. These fertilizers were applied at two levels of fertility, i.e. 20 lb. and 40 lb. nitrogen per acre, with and without phosphorus added at the rate of 40 lb. P_2O_5 per acre.

Significant yield responses to nitrogenous fertilizers were obtained in the three seasons. Maximum or near-maximum yields were produced by ammonium sulphate-nitrate, ammonium nitrate and urea, while lowest yields were obtained by ammonium chloride or ammonium sulphate among the synthetic form of nitrogen. There was no significant difference between the last two. Organic manures gave much lower yields than the synthetic ones. Of the two levels of nitrogen, 40 lb. per acre level gave highly significant yield increases as compared to 20 lb. per acre level. The application of phosphorus either alone or in combination with nitrogen did not prove to be of any value in increasing the yield. There was no significant difference in the crude protein content by different forms of applied nitrogen, alone or in combination with phosphorus. The percentage of applied nitrogen recovered in the grain decreased with increased nitrogen rates. The regression analysis employed to study the relationship between yield and crude protein content of Pearl millet grain showed that there was no significant correlation between the two. So far as yield and crude protein content of Pearl millet grown on *goradu* soil are concerned, there is no difference between ammonium chloride and ammonium sulphate.

23. Effect of fertilizers on the mineral contents of pearl millet (*Pennisetum typhoideum*—Rich.) straw.

H. C. SHAH and B. V. MEHTA, Anand.

With a view to study the variation in the mineral contents of Pearl millet (*Pennisetum typhoideum*-Rich.) straw as affected by the application of ammonium chloride and other fertilizers, field-experiments were carried out at the Institution of Agriculture, Anand (B.S.) over a 2-year period covering 3 crop seasons. Pearl millet was grown on sandy loam soil popularly known as *goradu* soil, and was fertilized with ammonium chloride, ammonium sulphate, ammonium sulphate-nitrate, ammonium nitrate, urea, groundnut cake and farm-yard manure, at the rate of 0, 20 and 40 lb. of nitrogen per acre, with and without phosphorus added in the form of superphosphate at the rate of 0 and 40 lb. of P_2O_5 per acre.

Application of nitrogen increased crude protein, phosphorus chlorine, magnesium and potassium contents of both the leaf and the stem but decreased the calcium content, while in the case of sodium there was either no change or a slight increase. Application of phosphorus increased crude protein, chlorine, calcium, and potassium contents of both the leaf and the stem, but decreased the magnesium and sodium contents and gave no increase in the phosphorus content of the leaf and the stem. 40 lb. nitrogen per acre applied as a fertilizer increased the nitrogen, phosphorus, chlorine, magnesium and potassium contents to a greater extent than did 20 lb. nitrogen per acre. There was no regular trend in the sodium content while in the calcium content there was a decrease over control due to both the levels of fertilizer nitrogen.

Generally, ammonium chloride gave higher crude protein, phosphorus, chlorine, and magnesium contents than ammonium sulphate but in the case of calcium and potassium contents it was next to ammonium sulphate.

Crude protein, and phosphorus contents of both the leaf and the straw were higher in monsoon than in summer, while chlorine, magnesium, and potassium contents were higher in summer than in monsoon. The leaf was richer in calcium and sodium contents in monsoon than in summer, the stem was richer in calcium content in summer than in monsoon, and the sodium content of the stem was practically unaffected by the season.

24. Accumulation and movement of Minerals in *Bavto (Eleusine coracana,* Linn., Gaertn.).

P. B. KHATRI and B. V. MEHTA, Anand.

Bavto is an important minor cereal crop, its importance being only next to *bajri* (*Pennisetum typhoideum*, Rich.). It forms the staple food of lower middle class and poor families. Usually it is grown in lighter soils and in dry areas where nothing else can be grown at any rate so well. At present we have little information regarding the quantities of nutrients removed by this crop. The present study deals with the growth and development of *Bavto* plant in relation to accumulation and movement of macro-nutrients at different stages of growth. The results are :— (1) maximum accumulation of nitrogen takes place between the growth and the preflowering stages, of phosphorus between the preflowering and the milk stages, of calcium between the milk and the dough stages, of magnesium between the dough and the harvest stages while potassium is almost uniformly absorbed from the growth up to the dough stages. (2) At all stages of growth, the percentage of potassium is greater in the stem than in other tissues, while that of calcium and magnesium is higher in the leaf and the root than in others. The grain is richer in nitrogen than the other tissues. (3) The highest total cation concentration is in the leaf. Potassium ion concentration in any tissue of this crop is greater than that of calcium or magnesium ions at the corresponding stage of development. Cationic ratio $\frac{(Ca+Mg)}{K}$ is lowest for the stem and highest for the leaf and the root, showing a dominant role of potassium in the stem, while calcium and magnesium have a dominant role in the leaf and the root. (4) The amounts of nutrients removed by *Bavto* crop producing about three tons of dry matter per acre are : nitrogen 51 lb., phosphoric acid 58 lb., potassium 154 lb., calcium 52 lb. and magnesium 20 lb.

25. Accumulation of movement of Mineral in *Kodra (Paspalum scrobiculatum,* Linn.).

P. B. KHATRI and B. V. MEHTA, Anand.

Kodra is an important minor cereal crop of Kaira district. It is a substitute for rice and forms the staple food of middle class and poor families. It is a drought-rasistant crop and fares better in sandy loam soil of Kaira and sandy soils of Northern Gujarat than in other soils. At present we have little information regarding the quantities of minerals removed by this crop. The present study deals with the growth and development of *Kodra* plant in relation to uptake and assimilation of macronutrients at different stages of growth. The results are :— (1) Maximum accumulation of nitrogen takes place between the preflowering and the milk stages, of phosphorus, calcium and magnesium between the milk and the dough stages and of potassium between the dough and the harvest stages. (2) At all the stages of growth, the percentage of potassium is greater in the stem than in other tissues. The percentage of calcium and magnesium is higher in the leaf and the root than in other parts. The grain is richer in nitroeen and phosphoric acid than the other tissues. (3) The amounts of nutrients removed by *Kodra* crop producing about two tons of dry matter per acre are : nitrogen and phosphorus each 32 lb., potassium 87 lb., calcium 12 lb. and magnesium 7 lb. (4) The highest total cation concentration is in the leaf of this plant. Potassium ion concentration in any tissue of this crop is greater than that of calcium or magnesium ions at the corresponding stage of development. Cationic ratio $\frac{(Ca+Mg)}{K}$ is lowest for the stem and highest for the leaf and the root, showing a dominant role of potassium in the stem, while calcium and magnesium have a dominant role in the leaf and the root.

26. Effects of Maleic hydrazide on growth and reproduction of an early variety of rice.

G. MISRA and G. SAHU, Cuttack.

The effects of two different methods of application of maleic hydrazide was studied on an early variety of rice, N. 136. The treatment consisted in series I of soaking the seeds for 72 hours with different concentrations 1, 10, 100 and 1000 parts per million (ppm) of maleic hydrazide solution and in series II of foliar spray once a week with the very same conecntrations beginning with 21 day-old-seedlings till the time of ear emergence. The seeds soaked with higher concentrations of 100 and 1000 ppm showed a marked decrease in the percentage of germination. The few seeds which germinated also failed to produce seedlings. Hence no further data could be collected from these two sets. Those soaked with lower concentrations of 1 and 10 ppm exhibited a poor vegetative growth but there was no significant difference in flowering nor in the yield of grains in comparison with the controls. The plants of the spray series exhibited great variability in their response with the different concentrations. Vegetative growth was considerably curtailed in the set sprayed with the highest concentration of 1000 ppm. Flowering was significantly delayed in this particular set also. Grain yield was significantly higher in the two sets sprayed with 1 and 10 ppm whereas it was lower in the other two sets sprayed with 100 and 1000 ppm in comparison with the controls.

27. Studies on nutritional requirement of Jute—I. Pot-culture experiments on the effect of different inorganic Nitrogen fertilizers on two species of Jute.

B. K. DE SARKAR, Barrackpore.

Pot-culture experiments were conducted with (a) Ammonium sulphate, (b) Amonium Chloride, (c) Ammonium Phosphate, (d) Ammonium Sulphate-Nitrate, (e) Amonium Nitrate, (f) Sodium Nitrate, (g) Potassium Nitrate, (h) Calcium Nitrate, on *Corchorus Capsularis* Var-D154 and *C. Olitorius* Var. JRO-632. Periodic records of growth in height, basal diameter, total green weight, Dry fibre weight and Fibre percentage were taken. The important results were as follows :—

(1) All the treatments gave significantly better results with specific differences than the non-treated control plants.

(2) The percentage rate of growth varied at different stages, showing maximum upto 35 days growth after which the rate decreased gradually. This showed that vigorous utilization of the fertilizer was maintained up to about 40 days from its application in both the species.

(3) Amongst the different fertilizers Ammonium sulphate gave the best performance and as a whole the ammonical nitrogen fertilizers were more effective than nitrate nitrogen.

(4) More green weight and corresponding dry fibre weight were produced as a result of treatment with ammonical salts than with nitrates, JRO-632 (Olitorius) responded better to Ammonium phosphate than D154.

(5) But significantly the calculated fibre percentage in terms of green weight showed higher values in Nitrates than in Ammonical salts showing the importance of Na, K and Calcium in actual fibre production in addition to sources of Nitrogen.

28. Studies on the nutritional requirement of Jute—II. The effect of foliar application of fertilizers on the growth and development of jute.

J. R. SAHA, Barrackpore.

Equal conc. of 0·1% level of available nitrogen in solution of Urea, Ammonium Sulphate, Potassium Nitrate and Ammonium Chloride were sprayed on the leaves of D-154 (capsularis), JRO-632 (olitorius). Spraying was started at two different ages of 30 and 45 days of plants. The spraying was done twice a week and continued till flowering. The following observations were made :—

(1) It was found that Urea sprayed plants gave highest yield followed closely by Ammonium Sulphate in both D154 (Capsularis) and JRO-632 (Olitorius).

(2) The effect of Potassium Nitrate spray also gave a higher yield but it seemed to be more effective in JRO-632 (Olitorius) than in D154 (Capsularis). The effect of Ammonium Chloride was not clearly indicated.

(3) The rate of absorption of different nutrients by leaves was estimated after 3 hours and 6 hours from the time of application. It was found that the nitrogen content of the leaves showed appreciable increase from the time of spraying as compared to control. This showed that fertilizers sprayed over the leaves were quickly absorbed.

29. Manganese nutrition of plants—IV. Effects of lime, sulphur, iron and manganese applications.

S. C. MANDAL, Kanke (Ranchi).

Pea plants were grown in pots containing six soils of Bihar with lime, sulphur, manganese sulphate and ferrous sulphate as soil amendments with a view to finding out their effects on the manganese nutrition of plants. The pH of these soils varied from 5·5 to 7·5. Lime was added to the acidic soils and sulphur to the soils of alkaline reaction. Lime depressed the manganese nutrition of plants quite significantly, while sulphur increased it. Iron too depressed the manganese uptake, generally, more in acid soils than in neutral or alkaline soils. But lime was three times more effective than iron in depressing manganese uptake in acid soils. Maximum uptake of manganese, however, took place in plants growing in manganese treated soils. Neither the ratio of available Fe and Mn nor the ratio of available Ca and Mn in the soil could be regarded as an index of manganese nutrition of plants. Similarly, no correlation could be observed between these ratios in the leaf and the health of the plant or its ultimate yield. Absolute quantity of active manganese in the soil appears to be of much greater importance than any of the ratios, Fe/Mn or Ca/Mn in spite of the depressing effects of Ca and Fe on the manganese nutrition of plants.

30. Effect of pre-treatment of seeds of Tung (Aleurites fordii, Hemsl.).

SALIL KUMAR CHATTERJEE, Mungpoo, Darjeeling.

(1) At Cinchona Plantation of Government of West Bengal, Tung (A. Fordii) is being successfully introduced amongst many other subsidiary crops during present years in view of the uncertain future prospects of Quinine.

(2) To minimise the period of germination and other difficulties often experienced in the nursery different pre-treatments have been applied to the seeds prior to sowing.

(3) Equal number of seeds have been soaked for 24 hours in different hormonal solutions of concentrations 50, 100 and 1000 ppm. Hormones, IBA, IAA, TCP, 2-4-D, and other chemicals viz., Fernoxone and Hortomone A have been tried. Besides hot water treatments (100°C) for 1mt, 2mt, 5mt and 10mt have been followed.

(4) As compared with controls, total percentage and the rate of germination were much enhanced in two lower concentrations of all the chemicals viz., 50 and 100 ppm. 1000 ppm. of IBA, TCP, Fernoxone and Hortomone however proved to be toxic when compared with 2-4-D, IAA and with controls. Of the different

hormones TCP, 2-4-D and IAA however showed increased effectiveness than the others. One minute hot water treatment compared favourably with controls.

(5) The promotion of early rate of germination as well as the increased percentage of germination as a result of pre-sowing treatments of seeds with hormones and other chemicals may be explained as due to acceleration of reaction that are supposed to be active during germination.

(6) Seeds contain reserves of various hormones recieved from mother plant and concentrated chiefly in the endosperm or cotyledons. And it is natural to assume that the concentration of hormones of normal seeds is below the optimum for the development of the embryo. Hence the enhancement of germination in treatments is due to the increase in the concentration of hormones towards the optimum in the embryo.

31. Effects of 3-Indolyl Butyric Acid, 2-3-5-Tri-iodo-benzoic Acid, and β-naphthoxy-acetic Acid on the Time of Flowering, Flower Diameter, and Flower Weight of the Cauliflower *(Brassica oleracea botrytis)*.

B. C. DAS, Calcutta.

A study was undertaken to investigate the effects of three synthetic phytohormones, 3-Indolyl Butyric Acid, 2-3-5-Tri-iodo-benzoic Acid, and β-naphthoxy-acetic Acid, on the cauliflower (*Brassica oleracea botrytis*). The experimental objectives were to determine which hormones, dosage range, and frequency of application would be most effective in increasing flower weight; to obtain information on the rate of growth and the relationship between height before flowering, final flower diameter, and final flower weight; and to see if the application of synthetic phytohormones affects the time of flowering. The three hormones were applied at four dosage levels, 0·01, 0·2, 4·0, and 80·0 parts per million, and at three frequencies, every 6th, 4th, and 2nd day in a 12 day cycle. All possible combinations of hormone, dosage and frequency were investigated using a Youden Square design for 37 treatments, including an untreated control, with 9 replications of each treatment. The following measurements were taken on each of the 333 plants; height before flowering, diameter measurements every second day, and final weight. The final weight data were analyzed by analysis of variance, which showed that the treatments differed significantly ($P < \cdot 01$). The most improvement over the control was shown by β-naphthoxy-acetic acid, with 3-Indolyl-butyric acid and 2-3-5-Tri-iodo-benzoic acid showing decreasing amount of improvement over the control. For all hormones, the most effective treatment was at a concentration of 80·0 parts per million applied every two days. The results also suggest that final weight can be predicated more accurately from the height of the plants before flowering than from the final flower diameter. It is suggested that treatments with synthetic phytohormones at low concentrations may be of interest to commercial cauliflower growers.

32. Studies on germination of spring (Boro) and summer (Aus) paddy to determine dormancy and viability.

B. N. GHOSH, Chinsurah.

Germination studies were made on four boro varieties, Chinsurah boro-I, Assam-I, Kakuria and D. I. 3, and three aus varieties, Dhairal, Marichbutti and Bhutmuri, for two years from the seed collected during both Kharif and boro seasons to determine dormancy and viability. First counting of the germination was recorded after 15 days of harvest and then monthly record taken up to one year, after that yearly counting was made.

There is difference in germination after harvest in the seed of the same variety collected during Kharif and boro season. Seed of Kakuria shows no dormancy when collected during boro season, while the seed collected during Kharif shows slight dormant period, the germination percentage being 59·2. In Bhutmuri and D.I.-3 the percentage of germination after harvest during boro season is higher than in Kharif, the increase being 25·9 and 34·7% respectively. In Assam-I greater percentage of germination is noticed in the seed collected during Kharif season, the increase being 36·8%. There is no dormancy in Chinsurah boro-I as the seed of both the seasons germinates more than 95 per cent after harvest, while a definite dormant period is noticed in Dhairal and Marichbutti.

As regards viability, the varieties maintain their optimum germination throughout the first and second year, except in the seed of Kakuria collected during Kharif season the germination drops after 10 months from 60·5% in the first year to 14·6% in the second year, but no such deterioration is observed in the seed collected during boro season.

From the above result, it seems that the difference in dormancy and viability of the rice seed collected during Kharif and boro season is possibly due to the difference in moisture content of the grain, and temperature and relative humidity of the atmosphere during development of the grain in Kharif and boro seasons.

33. Nursery experiments for raising seedlings of Cardamom (White), Cashewnut and Sandalwood.

SALIL KUMAR CHATTERJI, Mungpoo.

1. In view of the uncertain future prospects of Quinine, the possibility of growing number of subsidiary crops are being studied at Government Cinchona Plantations, Mungpoo, Darjeeling, recently.

2. Some interesting observations on germination study and on raising of seedlings of Cardamom-White (*Amomum aromaticum*), Sandalwood (*Santalum album*) and Cashewnut (*Anacardium occidentalis*) are being reported in the present paper.

3. Seeds of Cardamom, Sandalwood and Cashewnut were obtained from South India and were arranged to show in the experimental nursery under wide variations of conditions (of shades, sowing media and of season).

4. Cardamom has shown better response in lower shades—which in all probability have maintained the higher relative humidity. The responses have shown gradual diminution with increased shade heights. In almost all the cases, leaf soil + sand medium has proved to be better than leaf soil alone. It is interesting to note that Cardamom seeds have responded well to glass-top shade where both the total percentage of germination of seeds and number of days required for it have shown better response than the others.

5. The present trials show that under local conditions Leaf-soil + Earth (in equal proportions) to be much better than the Cow-dung + Earth + Ash. A sufficient increase in the percentage of germination and of established seedlings have been experienced in the present investigations. Basket planting proved to be more success than other trials. Results of field planting are being followed.

6. The seeds of root-parasite Sandalwood have preferred germination in leaf-soil medium more than in leaf-soil + earth. Closer spacing of seeds has given better results than wider spacing during germination trials. To find out suitable hosts for the root parasite—trials with *Lantana camara, Alnus nepalensis, Betula sp.* and *Acacia sp.* are being made at different elevations.

33A. Effects of growth substances on rooting of Jackfruit layerings.

P. K. SEN and T. BOSE, Calcutta.

Results of an experiment on the effects of Indole acetic acid (IAA), Indole butyric acid (IBA) Naphthelene acetic acid (NAA) and Maleic hydrazide (MH) in three concentrations each viz., 1000 ppm, 5000 ppm and 10,000 ppm in lanolin on layering of jackfruit, made by ringing (i) in the middle of May and (ii) in the middle of June, applied at the time of ringing are presented.

The treatments have resulted in significant increase in the number of roots formed and percentage of layers rooting. Among the three growth substances IBA has shown significant root promoting effect both under May and June ringing conditions. Between the two times of ringing, however, June ringing has given significantly higher rooting and among the three concentrations 5000 ppm. has shown the optimum effect. IAA and NAA have shown significant root promoting effect only under June ringing condition with 10,000 ppm. concentrations. MH has shown an inhibiting effect in rooting, increasing with increased concentrations.

33B. Physiological studies on oilseed crops—IV. Effects of phosphorus and sulphur deficiencies on Sesamum indicum Linn.

P. K. SEN and A. LAHIRI, Calcutta.

The results of an experiment on the effects of phosphorus and sulphur deficiencies on growth and yield of *Sesamum indicum* Linn. (Var. B-14) conducted in sand culture are presented. Normal culture solution provided the control. Three levels of deficiency of phosphorus and sulphur, singly and in combination, were employed the treatments being $\frac{1}{9}$P, $\frac{1}{81}$P, OP, $\frac{1}{9}$S, $\frac{1}{81}$S, OS, $\frac{1}{9}$P$\frac{1}{9}$S, $\frac{1}{81}$P$\frac{1}{81}$S, and OPOS. Plants under control produced normal growth as is usually found in good field conditions. Deficiency of either sulphur or phosphorus has shown characteristic symptoms and reduction in growth and yield, the deficiency effects increasing with increased levels of deficiency. Between the two elements, however, the effect of phosphorus deficiency is more acute, and under conditions of deficiency of both these elements phosphorus deficiency effects alone are evident. Sulphur deficiency while reducing number of branches and number of leaves and showing pale colour has little effect on the size and shape of the leaves which are normally unifoliate in the early stages and become lobed, and ultimately trifoliate in many cases, as they develop. Under phosphorus deficiency not only the number of branches and leaves are reduced but the size and shape of the leaves are also affected, the leaves being reduced in size and remaining unifoliate.

AGRI. CHEMISTRY

34. On the study of Coagulation of Hooghly River Water using different coagulant aid.

R. K. SEN, Barrackpore.

Study has been made on the coagulation of silt in the Hooghly River Water using Alum; Alum and Sodium Aluminate; Alum and Activated Sodium Silicate. From the nature of coagulation at different Hydrogen ion concentration, it is evident that the coagulation is due to exchange adsorption of ions and is not a case of mutual coagulation (mutual discharge of opposite charge particles). This view is substantiated by the ineffectiveness of negatively charged clay particles and positively charged hydrous aluminium oxide particles, especially in low pH. Inactiveness of aluminate ions in lower region of pH is due to its instability in pH (less than 7·0) whereas activated sodium silicate remains stable and gives rapid coagulation in this region.

35. Pedochemical approach to the study of some alluvial soils in the Ganga-Yamuna Doab.

R. S. MURTHY and P. L. DESHMUKH, New Delhi.

Pedochemical studies carried out in the Ganga-Yamuna Doab between North latitudes 26° 32′ and 27° 48′ and East longitudes 78° 30′ and 79° 30′ revealed marked differences in the morphological characters as well as in the physicochemical properties between the soils of the Ganga and Yamuna. While horizons could be differentiated in the latter on the basis of changing colour and texture, consistency, occurrence of lime and ferruginous concretions and internal drainage, soil profile remained almost uniform with depth in the former. Concretionary materials were entirely absent. The mean annual rainfall in the Doab practically remained the same but for slight local variations. Topography had brought in sufficient changes in soil formation. Illuviation of clay, sesquioxides, calcium and magnesium was prominently noticed in the soils of the Yamuna. Besides, the surface horizon was rich in organic matter and nitrogen contents. Moisture equivalent and moisture holding capacity of these soils were also high. There was practically no illuviation in the soils of the Ganga; clay content decreased with depth and sesquioxides remained uniform. Grading of fine sand indicated an increase in fineness of the particles at lower depths of the Yamuna profile despite a decrease in the fine sand content whereas in the Gangetic alluvium, the fineness of sand did not increase in proportion to the increasing sand content with depth. Although the predominant minerals in the light sand fraction of both the soils comprised of quartz, feldspar muscovide mica, feldspars had undergone complete kaolinization in the sand fraction of Yamuna soils while it was only partial in the other. The SiO_2/R_2O_3 ratio and cation exchange capacity of clays were characteristic of illite type of clay mineral.

In light of the above observations, it was concluded that the soils of Yamuna were somewhat mature while those of the Ganga were more recent deposits.

36. Influence of topography on the formation of black soils.

T. D. BISWAS and S. P. GAWANDE, New Delhi.

An investigation was undertaken to study how far topography influences the formation of black soil from basaltic parent material under uniform conditions of other soil forming factors, *viz.*, climate, vegetation, parent material and time. Profiles of black soils, collected on a continuous slope, in Amraoti (Bombay) were materials for this study.

Slope was found to influence, to a great extent, the formation and development of the profiles. Depth of the solum increases with decrease in the slope percentage and reaches maximum in the depression at the end of the slope (variation is from 4 inches to 27 inches) *pari passu* with the increase in the intensity of black colour and gradational change in the soil characteristics. The structure of the surface soils changes from granular to cloddy, texture from clay loam to heavy clay, pH from acidic to alkaline, free oxides of iron and aluminium, and base exchange capacities increase down the slope.

These observations lead one to infer that the profiles have been developed by the transport of fine soil materials downwards from higher slope and the deep profiles are formed by the accumulation of these soil materials under impeded drainage conditions. The uniform composition of the clay fraction and predominance of montmorillonite clay minerals support this view.

37. Free Oxides of Iron, Aluminium and Manganese in Four Types of Soils in Catenary Sequence.

SATRUHAN PRASAD and T. D. BISWAS, New Delhi.

Bhata, Matasi, Dorsa, and *Kanhar* are the four diverse soil types which occur in catenary sequence in the Raipur District of Madhya Pradesh. Free oxides of iron and aluminium in these four types of soils were found to be closely related to the toposequence in which these soils occur and the drainage conditions under which they have developed. Thus the red *Bhata* soil found on the elevated position is lowest in the content of these oxides whereas the black *Kanhar* soil in the depression at the end of the slope has the highest. The other two types viz., yellow *Matasi* and Brown *Dorsa* occupying the intermediate positions reflect the gradational characteristics. The more well drained the soils, less the content of free oxides of iron, aluminium, and manganese and *vice versa*. *Bhata* which has developed under free drainage conditions has the lowest amount whereas *Kanhar* formed under impeded drainage has the highest.

The mobility of these oxides within the profiles is closely related to the soil reaction and accumulation is observed at certain depth depending on the change of soil reaction from acidity to alkalinity. The major portion of soil manganese appears to exist as free oxide.

The free oxides of iron, aluminium and manganese are mainly concentrated in the clay fractions.

38. Genetic Variations in Saline and Alkali Soils of South-West Uttar Pradesh.

R. S. MURTHY and B. K. SINHA, New Delhi.

A good deal of variation in morphology, nature and distribution of salts and exchange complex is noticed in the saline and alkali soils of South-West Uttar Pradesh comprising the districts of Etawah, Mainpuri and Etah, under similar conditions of climate and topography. Salinity alkali hazards have arisen due to (i) lowlying topograph, poor drainage and salt accumulation under extreme heat and evaporation, (ii) high water table and (iii) degradation. Soils in group (i) are hard at the surface, superficially cracked, the black alkali patches peeling off into fine flakes; structure is blocky and at times massive. Soils are both saline and alkali, predominant salts being $\overline{\mathrm{CO}}_3$, $\mathrm{HC\overline{O}}_3$ and $\mathrm{C\overline{l}}$ of sodium. pH and exchangeable sodium are very high; leaching of clay and organic matter is prominent. Group (ii) soils are characterised by patchy salt efflorescence at the surface; not so heavy in texture; ill developed structure; carbonates present only at the surface; no leaching due to high water table. Soils in group (iii) are very hard with no salt deposits at the surface; structure blocky; sodium carbonate entirely absent; pH near to neutral in the surface soil; low exchangeable sodium at the surface. On the basis of the above characteristics, soils have been classified into the following genetic groups.

1. **Saline-Alkali (According to U.S. Salinity Laboratory classification) or 'solonetz' or 'Black alkali' of Hilgard.**
2. **Saline-Alkali or 'sodium solonchak'.**
3. **Non saline-alkali or 'degraded alkali' soil of De'sigmond.**

39. Studies on Organic Phosphorus of Black and Red Soils.

S. P. RAYCHAUDHURI and H. ESHWARAPPA, New Delhi.

In the present paper, study has been made of physico-chemical properties of two neighbouring black and red soils from Raichur (Mysore). A pot culture experiment with the surface soils from Raichur for determination of efficiencies of different sources of phosphorus for barley crop, reveals that the application of phosphorus increases the yield of straw and grain of barley. With both the soils triple superphosphate is more effective as a source of P_2O_5 compared to farmyard manure. So far as the relative behaviour of three organic phosphates on growth and yield of barley crop on black soil is concerned, nucleic acid shows the highest performance, followed by calcium glycerophosphate, followed by phytin. In the case of red soil of Raichur in respect of the average yield of straw and grain, nucleic acid shows the best performance, followed by phytin followed by calcium glycerophosphate. Triple superphosphate and farmyard manure show the same effect in respect of yield but in respect of uptake of phosphorus in crop, triple superphosphate has better effect than farmyard manure. Phytin shows better effect on red soil than on black soil.

It is clear from the experiments that rate of hydrolysis of organic phosphates in black soils is slow during early stages of crop growth and was rapid when phosphorus was mostly needed by the crop.

40. Studies on the fertility status of some peaty, marshy and swampy soils.

S. P. RAYCHAUDHURI and V. GOPALA SWAMY, New Delhi.

In the present investigation during 1958, attempts have been made to understand the fertility status of eight profiles consisting of twenty-seven soil samples collected from the "Peaty areas of Kuttanad (Kerala), marshy areas of Sunderban (West Bengal) and from swamps of Bhubaneswar Agricultural Farm, Orissa" and to suggest a tentative classification of these soils and their reclamation practices.

The above soils having widely differing environment, were studied for their morphological, chemical and to some extent mineralogical characteristics.

All the soils investigated are on the acidic side with the pH ranging from 3·8 to 6. Those rich in clay and inorganic matter have greater reserves of acidity than the soils of lighter texture and lower content of organic matter. The C/N ratio of soils from Kuttanad is generally very high, whilst it is generally normal in the case of other soils. The soils from Kuttanad and Sunderban contain appreciable amount of salts which restricts the yield of many varieties of crops whilst salinity effects are negligible in the case of Bhubaneswar Farm soils.

From the values of total nitrogen, P_2O_5 and K_2O, and available P_2O_5 and K_2O, it is observed that the Kuttanad soils are medium, Sunderban soils are high and the Bhubaneswar soils are very low in their potential fertility status.

41. Fertility status of some acid soils in relation to availability of nutrients from some added nitrogenous fertilizers.

S. P. RAYCHAUDHURI and B. N. ACHARYA, New Delhi.

Study has been made of some physico-chemical properties of four profile samples having pH values 5·5 or less. Similar study has been made with ten surface samples (0-6"). And a pot culture experiment has also been carried out with surface sample of acid soil (pH 5·5) from North Bengal with wheat in presence and absence of lime and organic matter and with addition of 30 lb. nitrogen per acre as ammonium sulphate.

It has been observed that the pH value of the soil profiles varies in different layer. The profiles as well as the surface samples are high in content of organic matter and nitrogen. In case of profile samples nitrogen and organic matter decrease with the depth of the profile. Total phosphorus (P_2O_5) is low in majority of the cases and is moderate in some cases and in few cases moderately high. The total potash (K_2O) is low except in one profile (Shillong profile) where it is high. The total CaO is generally medium. The percentage of clay varies from 44·00 to 11·35 in the case of profile samples and from 20·75 to 45·25 in surface samples. The silica sesquioxide in HCl extract shows that the total quantities of soluble materials vary between 70-80 per cent in the profiles and in surface samples HCl soluble materials varying from 64 to 70 per cent.

The results of the pot culture experiment show that the application of nitrogen increases the yield of straw and grain and placement has no beneficial effect over the surface application. Liming increases the yield and also the uptake of phosphorus. Next to lime the organic matter has got beneficial effect on uptake of phosphorus and yield of straw and grain. Liming also increased the pH of the soil from 5·5 to 6·1.

42. Phosphate fixation by Laterites and associated soils of West Coast of India.

K. V. S. SATYANARAYANA and Y. NAGRAJA RAO, New Delhi.

Some carefully collected type samples of laterites, detrital laterites, red loams and red earths and brown forest soils have been studied for their Phosphorus fixation capacities. The phosphates used are acid phosphoric, Mono-, di- and tri-potassium phosphates. The free iron and aluminium contents of the soil have been determined by the dye (Alizarin Red-S) adsorption technique. The results obtained in this study have shown that both iron and aluminium actively fix added phosphates and in this are involved the surfaces available for fixation and also the degree of hydration and ionic effects On the extreme acid region the fixation is due to the iron compounds, and their hydration is also important. From about 4·5 to 7·0 pH, the aluminium ion plays a prominent role in the fixation of added phosphate. With increasing alkalinity the fixation decreases and in extreme alkali conditions the soils may loose their phosphates. Dye adsorption technique offers a general correlation with phosphate fixation.

43. On the nature of clays of alluvial soils of semi-arid and semi-humid tracts of India.

K. V. S. SATYANARAYANA and V. K. GUPTA, New Delhi.

Alluvial soils are agriculturally very important and they cover large tracts of Rajasthan, Punjab, U.P., Bihar, Bengal and the coastal and deltaic areas of India. As very little information is available on the soils of Rajasthan and Punjab, representative soils have been studied. At Suratgarh and Sumerpur of Rajasthan the average annual rainfall is respectively 9″ and 15″. At Nawanshahr, Punjab the average annual rainfall is 26″ and humid conditions prevail for nearly 150 days in an year. An examination of capacity showed that the soils contain illite group of minerals with some montmorillonite and beidellite type. It is concluded that the soils are best suited for agriculture if the water supplies can be assured for growing crops.

44. A Colorimetric method for the Determination of Cation Exchange Capacity of Soils and Clays.

K. V. S. SATYANARAYANA, R. P. DHIR and Y. NAGARAJA RAO, New Delhi.

Cation exchange capacity (C.E.C.) of soils and clays is an important property determined in many pedological studies. The routine methods are generally time consuming and frequently no two methods give the same value. The negative charge developed on clay varies with a change in pH. The determination of C.E.C. by leaching with a solution at pH higher than 7 and having divalent cation is favoured as it will measure the maximum number of negative charges that exist on the exchange complex of clay. In the present method the soil or clay is saturated with barium by leaching with barium acetate at pH 7·0 and 8·0 and the adsorbed barium ions are displaced with calcium chloride. Barium is precipitated as the chromate. The chromate is dissolved in 1 ·4 HCl and estimated colorimetrically. The method has given reproducible value while handling small quantities of soils and clays.

45. "Some Soil Types of Vindhya Plateau."

K. V. S. SATYANARAYANA and N. K. SHENDE, New Delhi.

In the Sohawal N.E.S. Block of Satna Dist. Madhya Pradesh, diverse soil types have been noticed in an intricate pattern. During the course of field work, it has been noticed that a close correlation exists between the parent materials, their topography and the soil types. Thus the limestone rocks gave rise to a clay type soil resembling the 'regur' soils; the red and gray shales produced a mildly acid sandy to clay loam soils. Where there is a mixture of parent materials the soils also show a mild acid gray brown top soils and a gray alkaline clay subsoil. The existence of these soils under identical climate may also be due to their 'paleo' origin.

46. Nature of the Soils of Jute Research Substation, Sorbhog (Assam).

S. GHOSE and M. K. MUKHERJI, Barrackpore.

The Sorbhog farm, the Assam Substation of the Jute Agricultural Research Institute is about 2 miles ENE from the Sorbhogh Railway station on the main line of N.E. Rly. From the topography and physiography of the place, it may be considered that the area was once the place of activity of R. Aye, R. Manas and R. Benki all tributaries of the R. Brahmaputra at different times during the last few centuries. Seven profiles were studied.

The soils in general are loose. The difference between the layers in a profile could mostly be marked by difference in the feel and the compactness due to difference in particle size. Structural, colour or other variations in the profiles are often not well marked. The layers are usually thin. There are 9 to 12 layers up to a depth varying between 49 to 68 inches, where water table was found. The top layers of the eastern profiles are grey, whilst in the subsoils there are dark coloured particles and this is more in northern ones In the subsoils of western and central profiles, in both the rows, there are some dark patches. The top layers of the NC and the two western profiles have granular structure and the western ones are slightly compact. The NE profile is the most sandy and the northern profiles are more coarser in texture than the southern profiles where actually some loamy layers could be found.

The top layers of all the profiles contain a large quantity of organic matter and gradually the amount falls down the profile. The rate of fall is more in the eastern profiles.

These data along with the data of physical, chemical, mechanical analyses show a two directional effect on the formation of the profiles.

47. Exchangeable potassium in *Goradu* soil of Gujarat (Western India) at different stages of growth of Pearl millet *(Bajri)* (*Pennisetum typhoideum* Rich).

B. V. MEHTA and C. C. SHAH, Anand.

Goradu soil is a well-drained alluvial soil and is fine sandy loam in texture. In pot experiments with this soil reported earlier, it was observed during six continuous croppings of Pearl millet (*bajri*) that the decrease in exchangeable potassium was less than one-fourth of the total amount of potassium taken up by crops. In these pot experiments potassium was determined only at the time of sowing and harvest. In the present study, exchangeable potassium content of unmanured *goradu* soil, which was either deep or shallow ploughed, was determined at five different stages of growth of Pearl millet (*bajri*) and also at monthly intervals during the fallowing period. It was found that exchangeable potassium decreased up to the flowering stage and continued to do so, although to a much smaller extent, up to the dough stage, but at the harvest stage, there was either no change or an increase. After five to six months of fallowing, the original exchangeable potassium level was restored.

48. Studies on the Microbiology of the Rhizosphere of Corchorus olitorius: II. Effect of Fertilisers.

A. K. BANERJEE and A. B. ROY, Barrackpore.

The microbiology of the rhizosphere of the jute plant as affected by age was reported previously. In the present investigation the effect of fertilisers has been studied. It may be stated that with increasing dose of compost, the R/S value for fungi increases but not with phosphate. This was also the case with actinomycetes. Rhizosphere effect of bacteria was always positive but had no relationship with the amount or nature of the fertilisers. R/S value in cases of *Azotobacter* did not increase with the increase in the amount of compost but increased with the increasing dose of superphosphate.

The nature of the root exudation was studied with reference to the amino acid content and it was found that between 5 days and 20 days after germination plants exuded a spartic acid, glumatic acid, serine, α-alanine, valine, leucine, glumatic acid, glycine and probably γ-aminobutyric acid when grown under aseptic conditions.

6-8 free amino acids were present in the soils and their number and amount varied with the nature and amount of applied fertiliser. Usually glycine, serine, and aspartic acid are present in small quantities and α-alanine, valine and leucine are present in larger quantities. In ammonium sulphate treated plots, the amino acids are usually less. With increasing dose of superphosphate, usually both the amount and number of amino acids have fallen but at higher doses along with nitrogen (ammonium sulphate), these have increased, particularly valine and leucine. Organic nitrogen (compost) has generally helped in the formation of amino acids but wherever inorganic nitrogen has been also added, the number and amount of different amino acids have tended to fall.

49. Nitrification of different Inorganic Nitrogenous Fertilisers in a Sandy Loam Soil.

S. C. CHAKRAVORTY and H. PAL, Barrackpore.

Jute is a bast fibre crop, the yield of fibre is dependent upon the vegetative growth of the plant. Of the plant nutrients, nitrogen is the most important and has been found to give the best response. Jute prefers ammoniacal nitrogen. A nitrogenous fertiliser which will maintain in the soil a level of available nitrogen for the longest time as well as which will maintain the ammoniacal nitrogen is likely to prove the best for jute. To study this with different fertilisers, an experiment was conducted. The fertilisers taken were ammonia, ammonium sulphate, ammonium chloride and urea The soil was maintained at a moisture equivalent equal to their water equivalent.

The data for fluctuation of ammoniacal nitrogen, nitrate nitrogen and total available nitrogen and also periodic data for oxidisable nitrogen and carbon have been presented.

It has been found that ammoniacal nitrogen falls in all the treatments. The ultimate amount of ammoniacal nitrogen was most in case of ammonium sulphate. In case of nitrate nitrogen, there has been a general rise. In case of urea, the rise was slow, but was prolonged.

From the data presented, it may be seen that by adjusting the time of application better results are expected from ammonium sulphate and urea and if applied together a better result is expected from ammonium sulphate than ammonium chloride. Oxidisable nitrogen and carbon increases most in case of ammonium sulphate, it may therefore be stated that ammonium sulphate is likely to be the best fertiliser for jute.

50. Correlation between Physical, Chemical, Electrochemical and Viscous Properties of Pure Clay minerals.

M. SARKAR, R. L. BANERJEE and B. CHATTERJEE, Howrah.

Studies have been made on the X-ray diffraction and differential thermal analysis and on the variations in the pH, specific conductivity, viscosity on the progressive addition of bases to the hydrogen clays prepared from two samples of bentonite, two samples of kaolin and a soil from Contai (Midnapur, West Bengal). X-ray diffraction, differential thermal analysis and fusion analysis data reveal that montmorillonite is the predominant clay mineral present in the two bentonites, kaolinite in the two kaolins and illite in the Contai soil. The electrochemical and viscous properties of these H-clays lead to the same conclusion. The potentiometric titration curves with bases of the H-clays prepared from the two bentonites are characteristic of monobasic acids showing one inflexion in the pH range 7C0 to 8·5. The total acidity calculated at the inflexion point in the titration curves with basis varies between 75 and 105 m.e. per 100 gm H-clay. The potentiometric titration curves of the H-clays isolated from the two kaolins with bases show two inflexion points, the first one between pH 6·5 and 7·5 and the second one between pH 7·5 and 10·0. The ratio of the total acids at the two inflexion points is about 2·0. The potentiometric titration curve of the H-caly from the Contai soil show three inflexion points at pH 6·0, 7·7 and 9·7 respectively The conductometric titration curves of the H-clay agree with the relevant potentiometric titration curves. The viscosity base concentration curves of H-clays from the bentonites show an initial decrease, then an increase to a maximum at about 70-80 per cent base saturation and a final decrease with gradual addition of the bases. In the case of H-clays from the two kaolins, viscosity gradually decreases tending to a more or less constant value with increasing base saturation, Similar curves of the Contai soil show an initial decrease, then an increase to a maximum at about 40 per cent base saturation and a final decrease tending to a constant value.

A good correlation has thus been observed between the physical, chemical, electrochemical and viscous properties of H-clays prepared from pure clay minerals. The work has been carried out under the Scheme of I.C.A.R.

51. Nature of Irrigation Water affecting the available Nitrogen Status and Microflora of the Soil.

A. K. MONDAL, A. B. ROY and M. K. MUKHERJEE, Barrackpore.

In a double cropping programme of jute and aman paddy, the jute should be sown early as the date of transplantation of aman paddy is very important. It is often therefore necessary to sow jute with irrigation and irrigate the lands thereafter. Jute also responds very much to nitrogen, and prefers ammoniacal nitrogen. How far the nature of irrigation water affects the available nitrogen status as well as the soil microflora should be known before a programme of irrigation is taken up. With this point in view two samples of soil, one received very high doses of ammonium sulphate and other compost were selected. The different types of water used were—highly saline (canal hightide), just saline (canal lowtide), soft but slightly alkaline (pond), hard (tubewell), rain water and distilled water. The nature of the soil was sandy loam.

It has been found that ammoniacal nitrogen has increased when ammonium sulphate treated soils were irrigated except with lowtide canal, water and tapwater. In case of compost treated plots, the decrease was observed when tapwater and hightide canal water were used. The best increase in both the cases were from pond water. Nitrate nitrogen has increased in all the cases. With tubewell water however, the total available nitrogen was lowest showing thereby hard water is unsuitable for irrigating jute field.

The *Azotobacter* population has increased in all the cases, but the best response has been from the pond water. Actionomycetes and other bacteria have generally increased but the behaviour of fungi has been somewhat different.

It may therefore be considered that of the different types of water tested, pond water is the best and tubewell water is the worst.

52. Physical, Electrochemical and Viscous Properties of Binary mixtures of Clay minerals.

M. SARKAR, R. L. BANERJEE and B. CHATTERJEE, Howrah.

Studies have been made on the X-ray diffraction and differential thermal analysis and on the variations in the pH, specific conductivity and viscosity on the progressive addition of bases to binary mixtures (50 : 50 by weight) of montmorillonite and kaolinite; montmorillonite and illite and kaolinite and illite. It has been observed that the individual clay minerals can easily be identified from the mixtures by means of X-ray diffraction and differential thermal analysis studies. Each clay mineral has been found to exert a marked influence on the electrochemical and viscous properties of the other. Identification of the clay minerals present in mixtures by electrochemical and viscous methods require careful consideration of the features of the potentiometric and conductometric titration curves, the variations in viscosity with increasing addition of bases, the number of inflexion points in the potentiometric titration curves, the pH at inflexion, the ratio of total acidities at inflexion, the number of maxima in the viscosity base saturation curves and similar other factors. The work has been carried out under the Scheme of I.C.A.R.

53. A comparative study of mineralisation of Nitrogen in oilcakes.

V. S. KULKARNI and N. V. BHIDE, Poona.

Laboratory studies of nitrification of three common oilcakes—groundnut, safflower and castor—both ordinary and deoiled in the three major soils of the Bombay State —medium black, goradu and Laterite—have been carried out. The striking differences between the three cakes in each of the soils and between the three soils with each of the cakes with respect to both ammonification and nitrification have been pointed out. The fallacy of comparing the efficacy of the different organic manures by comparing the amounts of available nitrogen i.e. the sum of ammoniacal and nitrate nitrogen, has been discussed.

The authors suggest that a better method of comparison of the nitrogenous manures will be on the basis of total mineralised nitrogen which also includes the amount of nitrogen lost during nitrification. Judged on this basis, it is found out that groundnut cake is the best in all the soils and that goradu soil brings about the highest mineralisation of all the cakes. They also found that de-oiled cakes are superior to ordinary cakes when used as fertilizers.

The authors also point out that with all the cakes in all the soils there is a loss of as much as 30 to 50 percent of added nitrogen and suggest for the experiments of prevention of such losses.

54. Phosphate availability in bonemeal on steam processing and grinding to finer particle sizes.

A. B. GHOSH, New Delhi.

Raw bones, containing 61·2% mineral matter, 4·1% N and 22·9% P_2O_5, on digestion under 40 lb. steam pressure for 4 hours, gave a product containing 74·0, 2·8 and 27·7 per cents of mineral matter, N and P_2O_5 respectively. The steam processed material was better in quality and could easily be ground to a fine powder. Powdered raw and steamed bonemeals were graded through 1/10″, 1/40″ and 1/100″ sieves, the first one resembling the 3/32″ size of commercial bonemeal fertilizer. Available P_2O_5 in these fractions were estimated by extraction with (i) neutral ammonium citrate solution used for water-insoluble phosphatic fertilizers and (ii) 2% citric acid solution used for basic slag. The second method is considered by some workers to be a better index of phosphate availability in bonemeal fertilizer.

In raw bonemeal passing through 1/10″, 1/40″ and 1/100″, 11·0, 35·9 and 58·3 per cents respectively of the total P_2O_5 were soluble in neutral ammon. citrate and the respective percentage solubilities in 2% citric acid were 25·6, 61·6 and 90·3. In steamed bonemeal passing through 1/10″, 1/40″ and 17100″, 21·8, 49·3 and 61·3 per cents respectively of the total P_2O_5 were soluble in ammon. citrate and the respective figures in 2% citric acid were 64·3, 80·9 and 88·9.

The results show that a small fraction of the phosphate in commercial raw bonemeal is available, which increases considerably on steam processing. The phosphate availability increases very rapidly with fineness of the particles as judged by both the methods. Steamed bonemeal has a much larger proportion of available P_2O_5 than raw for particles passing through 1/10″ and 1/40″ but when ground to 1/100″, there is little difference in phosphate availability due to steaming. The 2% citric acid method shows a higher amount of available phosphate than the neutral ammonium citrate one for all sizes in both the types of bonemeal. However, with finer particle sizes, this difference in extraction is relatively smaller than in coarser ones.

55. Some aspects of the Geomorphology of the Machkund Catchment.

AMAL KUMAR SEN, Calcutta

An attempt has been made in the paper to record certain observation of the important geomorphic features in the northern Machkund Catchment. Tectonic and geologic elements were studied and the author identified three sequence of uplifts.

The drainage pattern of the area is complex one and the 'Superposed' valley was distinguished in the case of the Machkund and the kinchor. Several 'nick-points' were identified The Duduma and Gurdai waterfalls were accounted not due to lithological differences, certain 'breaks' were explained due to 'static' rejuvenation,

Monadnocks were then studied with their accordance of summits The author traced three pene-plain surfaces and illustrated his findings with super-imposed and longitudinal profiles etc.

DISEASE AND PEST

56. Mode of ingestion in *Utetheisa Pulchella* Linn. (Arctiidae : Lepidoptera).

R. B. MATHUR, S. MASHHOOD ALAM and MUMTAZ A. KHAN, Aligarh.

In *Utetheisa pulchella* Linn., major part is played, during ingestion, by well developed muscular cibarium. Mouth-parts are much reduced with exception of maxillae whose galeae form proposcis. Mandibles are atrophied. Labrum is a thin sclerite controlled by labral compressor. Elastic nature of dorsal inner walls of galeae coils proboscis. Adductor muscles close stipital valve to prevent passing of blood from stipes to head. Basal muscle elevates base of proboscis to bring it more closely under labrum. Intrinsic oblique muscles pull anterior and posterior walls of galeae inwards creating blood pressure in proboscis which extends it. Food canal communicates posteriorly with cibarium whose dorsal and ventral walls are formed by epipharynx and hypopharynx respectively, Cibarium, in its turn, opens into pharynx by true mouth. The latter is closed by relaxation of dorsal and ventral dilators prior to suction of nectar, which is sucked into cibarium via food canal by action of its various muscles. The relaxation of muscles at its anterior and closes passage between cibarium and food canal. Finally, the food from cibarium is driven into pharynx by contraction of dilators of true mouth with an antagonistic action of the cibarial muscles.

57. Nutritional Physiology of Latheticus Oryzae Waterhouse.

(MISS) P. GUPTA, New Delhi.

Insects as a class require a source of vitamins of B complex in their diets. Its requirements vary from insect to insect. *Latheticus oryzae* which is a pest of stored grains was studied in relation to dietary deficiencies and a qualitative vitamin requirements for larvae has been worked out in the present communication.

By omitting one of the nine factors of vitamin of B complex it was possible to demonstrate that without thiamin, riboflavin, nicotinic acid, pantothenic acid or biotin larval growth was adversely affected and a very few insects could develop into normal adults. Some of the factors like choline chloride or riboflavin which are important in the diets of *Trogoderma* or *Tribolium* are of very little value for *Latheticus*. Folic acid, and p'-amino benzoic acid are not of any nutritional values.

58. Nutritional studies on Trogoderma Granarium Everts. III. Role of 'Essential' vitamins of B-complex.

N. C. PANT, and SWARAJ GHAI, New Delhi.

Trogoderma granarium Everts. is one of the most serious pest of stored products in India. A series of investigations were conducted on its nutritional physiology and some of the results are presented in the present communication. The larva of this beetle is susceptible to deficiencies of nicotinic acid to such an extent that it dies in a few days. Lack of choline chloride or pantothenic acid also effects the growth adversely. A medium with these three factors of vitamin B complex is inferior to the one which is further fortified with the addition of two extra vitamins viz. riboflavin and thiamin.

Quantitatively the requirement of *Trogoderma* larvae is about 15 μg./gm of diet for nicotinic acid, 10 μg. for pantothenic acid and 200 μg. for Choline chloride. All these are optimum in very much less quantities than those that are used in normal dietary formulations. Requirement of choline is rather difficult to explain as although the optimal point is near about 200-300 μg. as low a concentration as 5 μg. gives 70% emergence of adult while in its omission the diet, suddenly becomes extremely poor giving only 10% adults. The critical range seems to be between 0-5 μg./gm of diet which, if true, is rather a low value for insects requiring choline.

59. Mode of feeding in the Melon-Fly, *Dacus Cucurbitae* Coq., (Diptera: Trypetidae).

MD. ZAKA-UR-RAB and S. MASHHOOD ALAM, Aligarh.

The paper presents a coherent account of mode of feeding in *Dacus cucurbitae* Coq. The mouthparts are muscoid type consisting of rostrum, haustellum, and labellum. The complex rostrum comprises of clypeus maxillae and postmentum. Haustellum is composed of labrum and prementum, Labellum consists of labial palpi. The food passage is a continuous tube from prestomum to true mouth and consists of a distal labial gutter situated in haustellum, bounded anteriorly by epipharynx and posteriorly by ligula, and a proximal cibarial chamber bounded anteriorly by epipharynx and posteriorly by hypopharynx. Cibarium, provided with proximal, median, and distal dilators, is chief seat of suction. The labial gutter is capable of dilatation by muscles inserted on its anterior and posterior walls. The food, consisting of liquid matter, is sucked up by action of cibarial muscles through pseudotracheal channels, via prestomum into food gutter, thence into cibarium, and finally it reaches pharynx after passing through true mouth. Throughout its ascent muscles of varying description play important role.

60. Evolution of Resistance in Insects.

E. N. SUNDAR, New Delhi.

The striking ability of insects to develop tolerance to insecticidal action goes back to nearly last five decades. Although this evolutionary topic lacks the historical interest when compared to others, nevertheless, this phenomenon with its high degree of specialization involving genetical, physiological, biochemical and other complexities is a fascinating study of absorbing interest in the field of Economic Entomology

This paper deals with a brief evolutionary survey of the insecticidal resistance in insects. This includes the origin of resistance, genetics, behaviour, structure, storage and detoxification mechanisms, which generally contribute to this phenomenon of resistance in insects.

It has been shown in the above review that comparatively very little is known yet of the mechanism of most of these compounds and their reactions although they are presumably to be enzymatic in nature.

The use of organic phosphorous insecticides has opened a new field for controlling the resistant insects and the non-toxic products has its counter part in the metabolic conversion of certain other compounds. Recently there has been a report (Keiding J., Science, 123, 1956) that house flies showed resistance towards these cmpounds also. Probably many think that the large scale use of organic insecticides has led to the resistant species. This complex phenomenon poses many problems in genetics, ecology, animal behaviour, physiology and biochemistry.

61. Recent advances in our knowledge of systemic insecticides in relation to their action on plants.

E. N. SUNDAR, New Delhi.

Systemic insecticides are those insecticides which have the capacity to translocate readily throughout the plant system They are all phosphate-ester compounds and have the property to inhibit the neurohormone, cholinesterase enzyme. The recent upsurge in the use of these pesticides on plants has brought into sharp and somewhat embarrassing focus a number of closely related and poorly understood fundamental processes of plant physiology and biochemistry. However, the plant parts in the translocation and chemical detoxification of these pesticides are comparitively better understood.

This paper deals with the present knowledge of these insecticides in relation to various plant systems. This review includes the plant parts involved in exhibiting the uptake and chemical detoxification of these pesticides whether applied to seeds, root or shoot. Cell-to-cell transport then moves the chemical to and from the vascular translocation in the xylem or phloem remain unknown upto the present time. At all stages of uptake, movement, accumulation and metabolic conversions of the applied chemical can change its pathway and help or hinder its ultimate desired effect. These problems long neglected now present to many toxicologists and plant physiologists stumbling blocks to the rational development of systemic insecticides.

62. *Coptosoma ostensum* Dist—a pest of *Palas* (*Butea monosperma* with notes on its Coccinnellid predator *Synia melanaria* var rougeti Muls and egg parasite *Telenomus* species.

C. P. MALHOTRA and S. KRISHNASWAMI, Namkum (Ranchi).

Coptosoma ostensum Dist. is a small sized bug somewhat rounded, and has been noted as fairly serious pest of the leaves, tender shoots and inflorescence of the *palas* tree which is the most important lac host of the country. The adult bugs and nymphs cluster in large numbers on the tender shoots and inflorescence or on the under surface of the leaves and feed on the sap of the tree. Quite often the leaves and flower-buds dry up as a result and finally drop off from the tree.

The pest which is prevalent in the field throughout the year, assumes serious proportions between February and June-July; later the incidence declines with the onset of the monsoon rains. During the winter, the pest is seen in larger numbers in *Arhar* fields from where it migrates to *palas* in February to breed there.

Studies made on the life history of the bug showed that the egg period lasts for 3 days and the total nymphal period from 24 to 63 days during January-July. The bug moults three to five times in the nymphal stage but four moults were common. During a particular period, the nymphal period remained fairly constant irrespective of the number of moults.

This pest is attacked by two enemy insects namely a Coccinellid predator *Synia malanaria* var rougeti Muls and an egg parasite, *Telenomus* species, which seem to exercise some effective check on the pest in the field

Both adults and grubs of *S. melanaria* feed voraciously on the nymphs of the bug. The adult beetle consumed at an average rate of about 5 to 7 medium sized nymphs per day while an individual grub consumed from 27 to 72 nymphs during its larval growth period. Life-history studies showed that the egg period varied from 2-5 days during March to August, the larval period 8-15 days during March to May, the prepupal period always one day and the pupal period 4-7 days during March—May.

The egg parasite *Telenomus* species is also found throughout the year round and its incidence corresponds to the incidence of the pest. In the field the percentage parasitisation of the eggs gradually increases from the month of January onwards and at times it reaches a very high level of over 90% between March and June.

Observations made on the oviposition behaviour of the parasite have been described. Life-history studies revealed that the parasite takes 9 to 25 days for its development inside the eggs of the pest during the months of February to June.

63. Relative toxicity of insecticidal Films to just Hatched Larvae of *Chilotraea infuscatellus* Snell. (Pyralidae: Lepidoptera).

S. PRADHAN and J. P. SAHU, New Delhi.

Preliminary observations on the habits of the individual just hatched larvae of *C. infuscatellus* showed that practically all of them remain roaming about on the surface of the plant for a minimum period of 10 minutes before entering into the plant tissue. Hence, during the present investigation these just hatched larvae were made to crawl for 10 minutes on films of different strengths of nine different insecticides. Thereafter they were taken away from the insecticidal films and reared on their normal food under laboratory conditions. Mortality counts were recorded at intervals of 24 hours and the data thus collected 72 hours after exposure were subjected to probit analysis, the results of which are tabulated below :

TABLE I

Relative toxicity of insecticidal films to the just hatched larvae of *Chilotraea infuscatellus*, Snell.

Insecticides	Heterogeneity	Regression equation	LC.50 in gm. per 100 c.c. emuls. spray	Fiducial limit of LC.50	Relative toxicity
1. Parathion ...	$\chi^2(4) = 2·3243$	$Y = 1·9465x + 2·6423$	0·001627	0·001688 0·001544	119·115
2. Lindane ...	$\chi^2(3) = 2·2382$	$Y = 1·5107x + 1·5465$	0·01932	0·0280 0·01395	10·036
3. Endrin ...	$\chi^2(4) = 1·6440$	$Y = 3·3121x - 3·0307$	0·02659	0·02978 0·02059	7·288
4. Isodrin ...	$\chi^2(3) = 1·4030$	$Y = 1·7498x - 0·1671$	0·07866	0·11140 0·05758	2·126
5. p′p′-DDT	$\chi^2(3) = 2·6439$	$Y = 1·7322x - 0·6946$	0·1939	0·2704 0·1436	1·00
6. Dieldrin ...	$\chi^2(3) = 3·0290$	$Y = 2·1524x - 3·4797$	0·2869	0·3746 0·2240	0·675
7. Chlordane	$\chi^2(4) = 2·9224$	$Y = 2·6583x - 4·6231$	0·4169	0·4942 0·3311	0·465
8. Aldrin ...	$\chi^2(3) = 6·5936$	$Y = 3·5584x - 8·0311$	0·4593	0·5350 0·3653	0·422
9. Toxaphane	$\chi^2(3) = 1·3812$	$Y = 3·3082x - 7·3187$	0·5293	0·5590 0·4994	0·366

* In none of these cases the data were found to be significantly heterogenous.
Y = Probit kill. x = Log. concentration $\times 10^4$. LC.50 = Concentration calculated to give 50% mortality of the insect.

Observations on larvae which survived the insecticidal treatments gave an indication of a slight reduction both in larval and pupal periods; the sex ratio got disturbed in favour of males.

64. Evolution of control schedule for Pests of Maize.

S. PRADHAN, M G. JOTWANI and PRAKASH SARUP, New Delhi.

The object of the present investigations was to work out under field conditions, the details of control operations which can be considered as optimum taking into consideration both the cost of operation and the degree of control achieved. The insecticides tried were (i) DDT 0·1%, (ii) *gamma* BHC 0·1%, (iii) Endrin 0·05% and 0·1% and (iv) Systox 0·025% and 0·05%.

The experiment was carried out in the randomized block design, there being four replications for each of the five treatments (including control) and the size of each plot being 45′ × 20′. In all three sprayings with different insecticides were given. The first spraying was given 25 days after sowing the crop. The interval between the first and the second spraying was twenty-eight days and 24 days between second and third spraying. The statistical analysis of the data on population of *Chilo* larvae and pupae showed highly significant reduction due to BHC in the 1st and 2nd spraying, but in the 3rd spraying it was not effective obviously because of the fact that by this time the *Chilo* population had become rather stationary and inside the stalks. Similarly BHC indicated significant reduction in damaged plants in the 1st and 2nd sprayings but endrin, somehow, showed significant reduction in the 1st spraying only. Also significantly more number of cobs were obtained from BHC and endrin treated plots as compared to systox treated and control plots. These results are not final as the experiments are to be repeated.

65. New host and varietal preference of *Epicauta Coerulea,* Leuck (Meloidae; Coleoptera).

M. L. PUROHIT and J. G. PAWAR, Gwalior.

Meloidae beetles (Coleoptera) play a dual role of 'Friend as well as foe'. The beneficial role is served by the Trianguime larvae as well as some adult beetles as they feed on the grass-hopper-eggs. They are of medicinal value and are the only source of cantharidin oil which is of use in veterinary, Animal breeding and is a popular hair-tonic. The harmful role is played by the adult meloides as they are known to feed on the foliage, flowers and earheads of cereals, pulses, vegetables and fruits. Some species as *Epicauta pennsylvanica* are known as carrier of causal agent of 'Potato-Ring-rot disease.'

Meloidae beetles are known to be guided by the colour, chemotropisum and varietal preference. The authors have recorded for the first time *Epicauta coerulea,* Leuck (Meloidae) feeding on the foliage of sanhemp (*Crotolaria, juncea*) at the Central Research Farm, Gwalior (M.P.). The local variety and Ceylon variety of sanhemp were sown in close proximity. All the factors for both the varieties including the date of sowing, were the same. But the beetles showed very significant preference to the Ceylon variety to such an extent that there was 100% damage to that variety where as the local variety was absolutely free from the beetles attack. The incidence of the beetles started when the sanhemp crop was three weeks old. There were no flowers, even in vicinity, to attract these beetles. Thus it is evident that these beetles were attracted by the foliage only. *Epicauta coerulea,* Leuck is found to be very sensative to any disturbance and is fast running but is poor flier as compared to that of Mylabris spp. It is also found to be very gregarious to feeding on the foliage of sanhemp. In the early hours of the day (upto 10 a.m.) hand picking was found to be very convenient, effective and economical.

66. Studies in Resistance to some of the Insecticides by beneficial insects (Parasites).

E. S. NARAYANAN and G. G. KUNDU, New Delhi.

The last decade and a half will be remembered in the annals of applied entomology as the period when some of the most powerful organic insecticides ever known to man were discovered. Yet the DDT, the Gammaxene and the organo phosphorous componants though solving some problems related to agriculture and public health have also created new and more difficult problems. Of these the most serious and alarming is the evolution of resistant strain of insects like flies and mosquitoes. There is another aspect of this problem of insect resistance. The wide spread use of organic insecticides in fields and orchards bring about the destruction of parasites and predators that keep some of these pests under effective check. There is another class of insects like the honey bees that play an important role as pollinating agents bringing about a better and more bountiful harvest. The development of resistance in beneficial insects is therefore of vital importance to the economic entomologists.

Adult male and female parasites of *Bracon brevicornis* Wesm., a braconid wasp of great potentiality were subjected separately to 1 c.c. of 0·01% p-p' DDT and

0 005% lindane dry film for 24 hours exposure along with carrier control and untreated control through ten successive generations. Under three constant temperatues viz. 20±1°C, 26·6±1°C and 30±1°C and three relative humidities viz. 65±1%, and 75±1% and 85±1% and the mortality percentages showed the positive temperature co-efficient. The ratio of the median lethal concentration of the original strain and selected strain was used as a criterion of resistance development. At 20°C and 85% R.H. the development of resistance at the end of the 20th generation (inclusive of previously treated 10 generations) was in the order of 2·33 times in males and 2 87 times in females in case of p-p' DDT and 2·11 times in males and 1·62 times in females in case of lindane. Similarly, it varied at other temperatures and other humidities. So, from the results it is concluded that the parasite *Bracon brevicornis* can develop resistance to p-p' DDT and lindane and this resistance development in successive generations is due to the dynamic variation and environmental conditions rather than the inheritance of resistance through successive generations.

67. Relative efficacy of some fumigants against *Tribolium Castaneum* Herbst .

H. J. BHAMBHANI and G. ROUT, New Delhi.

Four fumigants viz., carbon disulphide, carbon tetrachloride, ethylene dichloride and EDCT mixture (3 : 1 by volume) were tried against *Tribolium castaneum* adults in empty flasks and in flasks partially filled with maize, barley and jowar. Each flask was of approximately 560 ml. capacity and was filled with about 160 gms. of the commodity. The insects were fumigated for 24 hours and the mortality counts were taken 5 days after fumigation. The data were subjected to probit analysis. It was found that in empty space, median lethal doses of carbon disulphide, carbon tetrachloride, EDCT mixture and ethylene dichloride for *T. castaneum* were 16 60, 39·63, 38 64 and 37·84 mg./1. respectively, which showed that carbon disulphide was most toxic and the latter three fumigants were more or less equal in toxicity. Median lethal doses of above mentioned fumigants were 17 66, 42·17, 57·41 and 58·48 mg./1. in presence of maize; 17·91, 55·59, 72·61 and 83·45 mg./1. in presence of barley and 19 95, 59·70, 129·10 and 132·70 mg./1. in presence of jowar respectively. These results thus showed that carbon disulphide was most effective against *T. castaneum* in presence of any of these commodities followed by carbon tetrachloride, EDCT mixture and ethylene dichloride. The results also indicated that jowar was highly sorptive commodity for all the fumigants tried followed by barley and maize.

68. "The effect of Temperature and Humidity on the Reproductive Potential of *Apanteles angaleti* Muesebeck."

B. R. SUBBA RAO and K. GOPINATH, New Delhi.

The vipionid *Apanteles angaleti Muesebeck* is a recently discovered larval endoparasite of the notorious pest, Pink boll-worm of cotton, *Pectinophora (Platyedra) gossypiella* Saunders. The pest enjoys a world-wide distribution and has firmly established itself as the most important pest in all the cotton growing regions of the world except Central America, Peru and Ecuador. The potential importance of the parasite can be made out from the fact that nearly 75% of the boll-worms were found to be parasitesed in the cotton field of the Indian Agricultural Research Institute and a large number of them have been imported by the United States Department of Agriculture for mass liberation and establishment in the cotton growing tracts of the South and South-western states. Investigations were taken up to study the parasite with special reference to its ecology to estimate the possibilities of the effective control of the pest in India and other parts of the world. In this series of investigations, attempts were made to study its reproductive potential to find out whether it can carve out an ecological niche in newly liberated surroundings, whether it can gain a population level enough to balance that of the pest and whether its rate of population growth can counteract that of the pest. The several factors that affect the reproductive potential of an insect are (i) genotype of the insect, (ii) temperature, (iii) humidity, (iv) nutrition, (v) oviposition stimuli and (vi) the presence of other individuals. The influence of these factors, excepting the first and the last, were studied in detail.

In the course of the present investigations it was noticed that the parasite did not have a well defined pre-oviposition period and began ovipositing immediately after emergence; copulation, perhaps, being the only oviposition stimulus. No change of dietetic habits was seen before oviposition started. In fact, the parasites were seen to readily oviposit even when they were denied all food from emergence. But the oviposition period was only one day and the number of 'larval eggs' i.e., eggs produced by food stored by larvae, laid were very few. The maximum number of eggs were laid at 26·6 °C. Increase and decrease in temperatures brought down the number of eggs laid, though at 20°C it was not significantly so. Effects of temperature on oviposition was most pronounced at a moisture level of 70% R.H., the difference between the maximum and minimum mean number of eggs laid at the different temperatures being the highest. At a moisture level of 90% R.H. the effect of temperature on the reproductive potential was not marked. The difference between the mean number of eggs laid was negligible. Though increased temperatures at this moisture level brought down the oviposition period, increased rates of oviposition made up the total number of eggs laid. Humidity had a great influence on the oviposition activities and the parasites prefer near saturation levels of R.H. for maximum oviposition. A comparatively dry atmosphere of 45% R.H. reduced the mean number of eggs laid to about one third. Among the commonly available laboratory feeds investigated, it was found that the parasites laid the maximum number of eggs when raisin was offered as food. The difference was highly significant when compared to 10% Sugar and 10% Sorbitol solutions. Sorbitol was expected to encourage egg production, but since the observed results do not suggest this and since the oviposition period was only two days, it may be assumed that the action of Sorbitol on the physiology of reproduction was nullified due to the absence of more vital nutrients. Light had a definite influence on the oviposition activity of the parasite. The total number of eggs laid was maximum at 26·6°C at a moisture level of 90% R.H. and in presence of light.

69. Comparative efficacy of some fumigants against *Tribolium Castaneum* Herbst. In presence of wheat.

H. J. BHAMBHANI and G. ROUT, New Delhi.

Experiments were conducted with carbon tetrachloride, ethylene dichloride and carbon tetrachloride mixture (3 : 1 by volume) and ethylene dibromide against adults of *Tribolium castaneum* in approximately 41·5 litre steel bins partially filled with about 60 lbs. of wheat of 8·3% moisture content. The caged test insects were kept at surface 9, 18 and 27 inches below the surface, the last level being 3 inches above the bottom of the bin. The fumigant was poured on the cotton wool kept on the surface and it had to penetrate a column of wheat to affect the insects buried at different depths. The fumigants were tried at the rates of 100, 150 and 200 mg./l. for 8, 16 and 24 hours. It was found that carbon tetrachloride when used @ 100 mg./l. for 16 and 24 hours gave 100% kill of the insects at all the levels, whereas, EDCT mixture when used @ 150 mg./l. for 24 hours produced 98·8% kill at 27" level and 100% kill at surface, 9 and 18 inches below the surface. In case of ethylene dibromide, a dosage of even 200 mg./l. for 24 hours gave only 10·1% mortality at 27" level. The results thus clearly showed that carbon tetrachloride was most effective followed by EDCT mixture and ethylene dibromide. When wheat of 6·6% moisture content was used ,ethylene dibromide @20 mg./l. for 24 hours was found to give 100% kill of the insects at all levels.

70. Root and Stem-root of 'Roselle" (*Hibiscus sabdariffa* Linn.) caused by a strain of *Phytophthora parasitica* Dast.

N. MUKHERJEE, Barrackpore.

During the months of July-August a serious outbreak of root and stem-rot of roselle (*H. sabdariffa* Linn.) caused by a strain of *Phytophthora parasitica* Dast. has been found in several districts of West Bengal. Plants having heights above four feet are generally attacked. Initially, the root-system is infected which in course of time become soft, moist and violet-brown in colour. Later on infection is also found on the stem which may spread upwards and downwards. In advance stage of the disease cracking of bark, gummosis and wilting are usually noticed. In culture the fungus favours sporulation at a low temperature and produces different types of sporangia on different media.

71. Physiological studies on Sitophilus Oryzae Linn. Oviposition and larval development on 'artificial grains'.

N. C. PANT and P. GUPTA, New Delhi.

Although during the last ten years valuable data on the nutritional physiology of a number of beetles associated with stored plant products have been collected as a result of the work done by various authors, yet practically nothing is known about the nutritional requirement of *Sitophilus* oryzae which is one of the most serious pests in India and elsewhere. This insect has defied all attempts to rear it on artificial diets because of its mode of oviposition and internal feeding larvae. In the present communication a method is described by which it will now be possible to study this insect and other internal feeders.

The food mixture consisting of casein was unsuitable but when it was replaced by gluten the insects behaved normally. The food either in pure substances or in the form of wheat flour was offered in the form of pellets made by kneeding the powder. It was possible to establish that a mixture containing the following ingredients is a suitable medium if offered as pallets :—

Gluten	50 parts	McCollum's salt mixture	2 parts
Starch	50 parts	Yeast	5 parts
Cholesterol	1 part	Water	10 parts

Yeast can be replaced by pure synthetic vitamins of B complex.

It has also been possible to replace protein part of the diet by a mixture of 19 amino acids.

72. Studies on the Feeding Habits of Beetles damaging fruit and leaves of Apple in the Hills of Uttar Pradesh.

A. HAQ, Chaubattia.

Studies on the feeding preferences and amount of each type of food consumed were made on seven common defoliating and fruit eating beetles of apple at Chaubattia (6585 ft. altitude) during August 1958. *Lachnosterna longipennis* Bl., *Hilyotrogus holosercus* Redt. and *Brahmina corracea* Redt., feed exclusively on leaves. *Xylotrupis gideon* Linn., *Protaetia neglecta* Hope and *Rhomborhina glabirhina* Westw. feed exclusively on partially rotten or over ripe fruits, externally damaged by some other agency. *Anomala dimidiata* Hope is the only beetle which can feed on sound and ripe fruits. It also feeds on leaves in the absence of fruit. None of the beetles is capable of feeding on sound and underripe fruits. The average food consumption is related to the body weight and it is about ½ and ¾ of the body weight on leaves and fruits, respectively.

73. Insects affecting Cabbage Seed Production and their control in the Hills of Uttar Pradesh.

K. M. GUPTA and J. C. JOSHI, Chaubattia.

Cabbage seed crop is adversely affected by *Brevicoryne brassicae* Linn., *Eurydema* sp. and *Pieris brassicae* Linn. during March-May in the hills. Field trial with 11 treatments applied 5 times at fortnightly intervals at Chaubattia (6585 feet altitude) in 1958 with an average dose of liquid spray of one lb. per plant indicated that Metasystox 0·025% was the most suitable treatment against the aphid, taking yield, percentage germination and cost into consideration, the average yield per plant being 2·6 oz. Parathion emulsion 0·01% was effective against *P. brassicae* while none of the treatment including Endrin, Parathion, Diazinon, Malathion was effective against *Eurydema*. Ekatin appeared to be phytotoxic while Nicotine sulphate ineffective against aphid.

74. Prevention of damage to Pomegranate fruits by Borer *(Deudorix epijarbas* Moore) in the Hills of Uttar Pradesh.

K. M. GUPTA and J. C. JOSHI, Chaubattia.

Larva of a butterfly *D. epijarbas* and fungus rots, *Zythia versomiana* Sacc. and *Aspergillus* sp. spoil about 56% fruits of pomegranate during June-August on the hills of Uttar Pradesh. Repeated field trials carried out near Ranikhet (Almora) during 1956-58, indicated that treating sound fruits by dipping them in DDT suspension 2% + Blitox 0·5% or DDT suspension 2% + wettable sulphur 4%, four times at 3-4 weeks intervals after the fruits had attained a diameter of about ½ inch, was effective in protecting on an average 82% fruits at a cost of Rs. 0·92 and Rs. 1·42, respectively, per 100 fruits, while covering fruits in muslin bags costs Rs. 7·20 and is much less effective. A labourer can easily dip 125-150 fruits per hour with the help of a mug consuming about 1- 1½ lb. of suspension.

75. Citrus Whitefly *(Dialeurodes citri* Ash.) and its Control in the Hills of Uttar Pradesh.

K. M. GUPTA and A. HAQ, Chaubattia.

Egg, larva, pupa and adult of *D. citri* occupy 26, 32, 53 and 5 days in summer brood (mid-March to mid-July) and 20, 30, 200 and 6 days in winter brood (mid-July to mid-March), respectively, at 4000 feet elevation. At altitudes between 5000-6000 feet, emergence of adults is delayed by 2-3 weeks. Field trials in 1954-58 indicated that lime-sulphur 1 :20, DDT emulsion 0·5% and DDT emulsion 0·5% + Sandolin 'A' 0·5% were the most suitable treatments against egg, larva and pupa, the cost of spray liquid per gallon being 21, 23 and 40 Naya Paisa, respectively, and the percentage control secured being 97·4, 93·8 and 98·3. Treatments during rainy season were less effective. DDT+Sandolin scorches young foliage and should be tried during winter only. Treatments effective against whitefly eradicate sooty mould (*Chaetothyrim* spp.) also. Diazinon, Malathion, Parathion, Dieldrin, Metasystox and Ekatin in various concentrations proved less effective.

76. *Stegobium Paniceum* (L.) as a Pest of Stored Turmeric in Rajasthan and its Control by Fumigation

B. K. SRIVASTAVA, Udaipur.

A severe attack of *Stegobium paniceum* (L.) on stored turmeric has been reported. The adult is a small beetle about one tenth of an inch long, cylindrical and uniformly light brown in colour. The eggs are laid loose among the stored turmeric. The tiny white grubs emerging from the eggs tunnel inside the turmeric. The heavily infested rhizomes become filled up with frass which comes out while cleaning. The full grown larvae pupate in small parchment like cocoons deep inside the tunnels. The entire life cycle is passed in about six weeks time during rainy season.

Fumigation tests with carbon tetrachloride (100%), carbon tetrachloride and ethylene dichloride mixture (25%+75%), carbon tetrachloride and ethylene dibromide mixture (95%+5%), ethylene dibromide (100%) and ethylene dichloride (100%) were conducted to determine their relative efficiency against the natural infestation of this pest. The dosages used were 10, 20, 8, 3 and 30 pounds per 1000 cu. ft. of space respectively with an exposure period of 24 hours. All the fumigants gave effective control of the adults. The pupae were hardest to kill followed by the eggs. It was found that carbon tetrachloride and ethylene dibromide mixture was significantly most toxic of those tested to all stages of the insect (killing 55·8% pupae, 97·4% grubs and 78·9% eggs) Next in order of effectiveness were ethylene dibromide, and carbon tetrachloride followed by carbon tetrachloride and ethylene dichloride mixture; ethylene dichloride being the least toxic.

77. Search for a Suitable Aphidicide against Peach Leaf Curling Aphid (*Brachycaudus helichrysi* Kalt.) in the Hills of Uttar Pradesh.

K. M. GUPTA, Chaubattia.

Peach trees suffer heavy losses due to infestation by *Brachycaudus* (*Anuraphis*) *helichrysi* Kalt. in the hills and submontane tracts. Field trials during 1956-58 indicated that D.D.T. emulsion 0·5% was the most effective aphidicide as a winter spray. In 1957-58, emulsions of Parathin 0·025, D.D.T. 0·5 and D.D.T. 0·25, Malathion 0·1, Diazinon 0·50 and Thiometon 0·02%, increased the yield of fruits by 211, 172, 156, 94 and 78 per cent, respectively, as compared to Control (No treatment), the average cost of insecticide for treating a medium sized tree being 12, 23, 12, 17, 34 and 14 Naya Paisa. The percentage of curled leaves was less than 3% in all the treatments as against 27 in the control. As a foliage spray during spring, Diazinon emulsion 0·05% and Thiometon emulsion 0·02%, reduced the population of aphids by 100 and 95%, respectively, but none of them reduced premature drop of fruits.

78. A Virus Disease of Garden Nasturtium *Tropaeolum majus*.

K. S. BHARGAVA and R. D. JOSHI, Naini Tal.

A virus disease of garden Nasturtium characterised by vein banding, mosaic mottling and puckering of leaves has been noticed in gardens in Naini Tal. The virus has been transmitted experimentally to seven species of plants. It is of non-persistent type and the insect vectors are *Myzus persicae and Brevicoryne brassicae.*

79. Control of the Greasy Cut-Worm (*Agrotis* ypsilon *Rott*).

A. C. SEN, Patna.

The Greasy cut-worm (Agrotis ypsilon Rott.) is enemy No. 1 of all *Rabi* (Winter) crops and in Bihar causes damage to the extent of 10 to 25% annually. Sometimes a whole field of 4 to 5 acres area is completely devasted. The insect in its caterpillar stage cuts the tender crop at the ground level. The caterpillar remains hidden under the crack and crevices of the soil during day time and starts its devastating activities after sun-set.

Effective control measures have been found out (a) treatment of the soil by broadcasting 10% D.D.T. dust at the rate of 30 lbs. per acre before sowing, (b) when the incidence of attack has been noticed, dusting the affected field with 5% BHC or 5% Aldrin at 20 lbs. per acre has been found very effective to kill the early instars of the caterpillar. Fully-grown caterpillars have been found killed in 8 to 10 hours time when sprayed with Parathion (Folidol E-605) and Endrin at the concentration of 0 04%.

The cost of such operations for the dusting comes to about Rs. 4/- and the spraying-cost with the latter group comes to about Rs. 10/- per acre. The effects of spraying operations remain potent for 4 weeks.

(c) By adopting cultural practice i.e., by altering the sowing time either earlier or later, to the usual sowing period, the pest incidence can be avoided without any additional cost.

80. On the biology of *Lema coromandeliana* Fabr. (Crioceridae).

G. C. SENGUPTA and J. N. DAS, Bhubaneswar.

Lema coromandeliana Fabr. is recorded as a pest of *Commelina bengalensis.* The life history from egg to adult takes about 33 days. A female was recorded to lay 30 to 40 eggs in the laboratory. Mating takes place after 4 to 5 days. The newly hatched larva is pale yellowish in colour. It feeds on chlorophyll of the leaves. The larva feeds and pupates inside the folds of the leaves under the characteristic covering of the excreta. The larval period is 8 to 10 days during August and September. The pupal period ranges between 10 to 12 days. The damage is less pronounced in the beginning i.e., July and increases with the advancement of season reaching the maximum during September.

81. Observation on *Toabala vishnou* Lef (Lasiocampidae).

G. C. SENGUPTA and J. N. DAS, Bhubaneshwar.

Life history, different stages, nature and extent of damage of *Trabala vishnou* Lef were studied in 1957-58. The eggs are laid in groups of 40 to 200 covered with hairs on the leaves of caster plants. The female moth derived from fullfed larva lays 120 to 216 eggs. Egg period varies from 8 to 11 days. The larva has cylindrical body with more or less dense clothing of secondary hairs. The larvae are gregarious, usually occur in large colonies and feed voraciously on the castor leaves. The larva undergoes 4 moults and 5 instars, and the larval stage varies from 25 to 30 days. The larva pupates with a cocoon of hair and silk. The pupal period varies from 10 to 15 days. The sexual dimorphism of adult moths has been described. The pest is active in the months of December and January. It is a very bad pest of castor in Orissa. The attacked plants are more or less completely destroyed with all the leaves being eaten up by the larvae.

82. Control of sugarcane black bug (*Macropes excavatus* Distant) with some new synthetic insecticides.

GURCHARAN SINGH SOHI and AJIT SINGH SIDHU, Ludhiana.

Sugarcane black bug (*Macropes excavatus* Distant) is a serious pest of ratooned sugarcane crop particularly during the premonsoon period in Kangra, Amritsar, Jullunder, Hoshiarpur, Ludhiana, Karnal and Sangrur districts of the Punjab. Both the adults and the nymphs feed gregariously in the central whorl of leaves and under the sheathing bases of the side leaves. As a result of the continuous drain of the sap due to their feeding, the leaves turn pale and present a sickly appearance. Characteristic holes may also appear on the affected leaves. The growth of the affected plants is adversely affected during the premonsoon period and the infested crop yields juice of a poor quality.

Trials for its control were carried out with BHC suspension (0·1%, 0·2% and 0·3%), endrin emulsion (0·005%, 0·01% and 0·02%), diazinon emulsion (0·005% and 0·01%) and parathion emulsion (0·005% and 0·01%) during May, 1958 at Panipat (Distt. Karnal) using 75 gallons of the spray material per acre. Control plots were sprayed with water. Spraying was done with bucket pump and each treatment was replicated thrice. While spraying with all the above insecticides in various concentrations used, resulted in significant reduction of the bug population, spraying with 0·01% parathion emulsion @ 0·075 lb./acre gave 91·6% and 98 2% mortality, 0·01% diazinon emulsion @ 0 075 lb./acre killed 75·2% and 89·4%, 0·02% endrin emulsion @ 0·15 lb./acre resulted in 90·1% and 96·1% mortality and 0·2% BHC suspension @ 2·25 lbs./acre affected a mortality of 86·5% and 91·5% of the nymphs and adults respectively. It was further observed that the phosphatic insecticides, though gave high initial kill, could not keep the pest properly suppressed because of their low residual effect.

83. Tests of insecticides for control of *Epilachna vigintioctopunctata* Fabr. (Coccinellidae).

G. C. SENGUPTA, N. PANDA and N. SHI, Bhubaneswar.

The spherical pale brown spotted beetles *Epilachna vigintioctopunctata* Fabr. (Coccinellidae) is the most important of the leaf feeding pests of brinjal in the State of Orissa.

A test to control this pest was conducted on brinjal local variety in the State Agricultural Research Farm, Bhubaneswar. The insecticidal dust formulations tested were BHC 5%, Toxaphene 5% and Dieldrin 1%. After 48 hours of application both BHC and Toxaphene were most effective insecticides treated against *Epilachna* beetles. But there was no significant result in the effectiveness of Dieldrin 1% dust. One week after the treatment the result shows the superiority of Toxaphene over BHC. There was an increase of grub population by 12·6% in the plots treated with Dieldrin 1% dust. Dieldrin 1% dust seems to have been too weak.

84. Nematodes Affecting Vegetable Crops.

A. C. SEN, Patna.

The incidence of infestation by the Nematode worms usually goes un-noticed as the affected plants do not wither out soon after infestation. The only visible symptom of attack is noticed by the stunted growth of the plant and reduction in crop yield. These features are often mistaken for lack of proper manure and fertility of the soil. During the course of field studies carried out in Bihar since 1954, *Bhindi*, Chillies, Gram, Tomato, Peas, Brinjal and Gourd plants were found affected by the Root-knot eelworm. The worms were found attacking the roots of the affected plants. The degree of infestation was more pronounced in areas subjected to water-logging condition for sometime.

Different species of Nematodes were found affecting different vegetable crops. Such as, *Meloidogyne javanica* L. (= *Heterodera marioni*) affecting the Gram, *Bhindi*, Tomato and potato plants. A new species, *Hoplolaimus spp.*, so far un-described, was also found attacking the *Bhindi* plants. Potato root eelworm was recovered only from Netarhat farm, situated at an altitude of 3,500 feet above sea-level.

GENERAL

85. Chemical Examination of the Grading of Flue-cured Tobacco.

A. S. SASTRY, Rajahmundry.

The flue-cured tobacco in India is graded mostly on the basis of colour (Marketing Series No. 70, Grading and marketing rules, Schedule II, 1937) while in U.S.A. the stalk position of leaves also is taken into consideration.

The present preliminary investigation is undertaken to see whether the grading procedures adopted in India are adequate on the basis of chemical composition of the leaves.

The different grades of flue-cured tobacco produced on the no-manure, F.Y.M. and N.P.K. treated plots in a manurial experiment at the Tobacco Research Sub-Station, Guntur were chemically analysed. It was found that on the basis of chemical composition, the grades fell into two broad categories, grades 1 to 4 which might be classified as good and grades 5, L.M.G. and D.G. which were poor. The former were characterised by high ash, low total N, high soluble solids, and total sugars, and high Kovalenko and Schmuck ratios, while reverse was true of the latter.

86. Fish-productivity of polluted waters with reference to Vellore Fort moat (Madras State).

A. SREENIVASAN, Bhavanisagar.

Vellore Fort Moat, with an area of 7 acres produces on an average, 2,544 lbs. of fish per acre per annum—a very good yield. It is polluted by sewage and sullage from the town and also by direct defeccation. A permanent and dense bloom of blue-green algae, esp. *Microcystis* is a characteristic feature of this water, though other organisms such as insect larvae crustaceans etc. are also present. The water is hard, has a high carbonate and bicarbonate alkalinity (sometimes also hydroxide alkalinity), a high chloride content, a high pH and fairly high dissolved Oxygen content. It has a high content of calcium also. The high productivity is attributable to the fertilizing effect of Sewage and due to the peculiar chemical conditions, including high phosphate content. Occassionally, mortalities do occur when sudden precipitation takes place and days are cloudy, resulting in hypo-oxygenation and production of hydrogen sulphide. The moat has yielded a good fishery of different species of fish including *Chanos* but Tilapia introduced recently, has not shown good growth so far. Judicious use of sewage for fish culture is indicated.

87. Effect of lactation stage and season on the calcium and phosphorus contents in the milk of Kankrej cows.

V. V. MISTRY and B. M. PATEL, Anand.

With a view to study calcium and phosphorus contents of milk at different stages of lactation and seasons, a number of milk samples collected from eight Kankrej cows at weekly intervals till the end of their lactations were analysed. A comparative study of herd milk sample was also done simultaneously. The results indicated that the calcium and phosphorus contents in Kankrej milk varied from 0·156 to 0·330 and 0·183 to 0·362 per cent respectively. The average calcium and phosphorus contents of 0·234 and 0·270 per cent indicate that the Kankrej milk is richer in these two mineral contents when compared with that of the other Indian and foreign breeds of cows.

A study of calcium and phosphorus content of milk at different stages of lactation reveals that the calcium content decreases from the beginning and reaches to a minimum in the 9th month of lactation after which it again increases in the later months. The trend of phosphorus content is almost the other way, indicating the inverse relationship of each other.

The calcium content of the milk in summer, monsoon and winter seasons were 0·248, 0·237 and 0·236 per cent respectively indicating that the milk in summer is richer by about 5 per cent than it is in other two seasons. Corresponding values for of the phosphorus content in the milk during the three seasons were 0·249, 0 275 and 0·300 per cent which show a gradual rise from summer to winter. Similar variations in case of both the minerals are also observed in the herd milk.

88. Composition of colostral milk of Kankrej cows.

(Lactose, minerals and vitamin C)

P. S. PATEL and B. M. PATEL, Anand.

Samples of first eight milkings, 12th and 16th milkings and the herd sample at 16th milkings were taken from 15 cows from a Kankrej herd at the Institute and were analysed with respect to lactose, chloride, ash, calcium, phosphorus and vitamin C.

From the results it is evident that the lactose content continuously increases from 3·09 per cent in the first colostrum to 4·86 per cent in the 16th milking. The lactose content at the 16th milking does not attain normalcy. The chloride content declines from 0·25 per cent in the first milking to 0·20 per cent in the second milking after which it is gradually reduced to the normal content of 0·10 per cent in the 16th milking.

The ash content of 0·91 per cent in colostrum was reduced to 0·82 per cent in second milking followed by a gradual decline up to 0·74 per cent in the 16th milking. The ash content in the herd milk sample is 0·72 per cent.

The calcium and phosphorus contents are not much variable. The average calcium content in colostrum is 0·25 per cent and in subsequent milkings it only decreases upto 0·22 per cent in the 16th milking. The calcium content in the herd milk is also 0·22 per cent, indicating that the milk has become normal on the eighth day after calving. Similarly the phosphorus content decreases from 0·33 per cent in the first milking to 0·26 per cent in the 16th milking. This value is little higher than the normal phosphorus content in the herd milk (0·24%).

The vitamin C content in the colostrum is 3·43 mg./100 ml., which is about twice the amount in the 16th milking (1·84 mg./100 ml.). The herd milk contains 1·50 mg./100 ml. which is still less, indicating that milk would become normal beyond eight days after parturition.

89. Iron and copper contents in the milk of Kankrej Cows.

V. V. MISTRY and B. M. PATEL, Anand.

Variation in iron and copper contents in the milk has been studied. It was observed that the average iron content for the individual animals during the experimental period varied from 0·604 to 0·853 mg./litre, the average being 0·725 ± 0·0286, while the copper content varied from 0·207 to 0·310 mg./litre, the average value being 0·233 ± 0·0235. Average iron content of all the animals, when compared with the corresponding value of the herd milk revealed that the latter was generally higher than the former. Similar trend was also observed in case of copper content but to a less extent. The higher iron and copper contents in the herd milk may be due to the fact that the herd milk was passed through and stored in iron and copper utensils while the milk samples of the individual animals were collected directly from the milk pan and stored in glass bottles. It was further observed that the animals secreted increased amount of iron in the later part of the lactation than in the middle part, however, a regular increasing trend from middle to later part of the lactation was not observed. No such trend was observed in copper content though at the end of the lactation its secretion was significantly lower.

90. Studies on nitrogen distribution in the milk of Kankrej Cows.

P. C. SHUKLA and B. M. PATEL, Anand.

The distribution of total nitrogen into various proteinous constituents in the milk of Kankrej cows was studied for one year. Weekly samples of milk from eight cows, together with fortnightly samples of herd milk were taken. The samples were analysed for crude protein, Casein, albumin, globulin, Proteose-peptones and non-protein nitrogen. The average values for milk samples of the experimental animals were, Crude protein 3·703, N.P.N. 0·171, Casein 2·877, albumin 0·332, globulin 0·233 and proteose-peptones 0·143 while for herd milk samples the values were Crude protein 3·612, N.P.N. 0·181, Casein 2·845, albumin 0·308, globulin 0·179 and Proteose-peptones 0·085. Though the average values for experimental animals were nearer to those of herd samples the difference in the maximum and minimum values for all the constituents in case of experimental animals was much more than that of herd milk samples. With advancement of lactation from second to fourteenth month increasing trend in the mean values from 3·368 per cent to 4·275 per cent in total nitrogen, 2·567 to 3·294 in Casein and 0·309 to 0·548 in albumin while decreasing trend from 0·283 to 0·152 in N.P.N. was observed. Proteose-peptones and globulin does not show any definite trend.

91. Nutritive value of *neem*-leaves (*Meelia asadirachta*).

B. M. PATEL, B. G. SHAH and P. C. SHUKLA, Anand.

A digestibility trial carried out on *neem* leaves with Chharodi hay as dry fodder reveals that they are highly nutritions providing 9·96 lb. of crude protein, 5·38 lb. ether extract, 12·32 lb. crude fibre and 44·63 lb. of N.F.E. The total digestible nutrients being 79·01. It is observed that all the nutrients in *neem* leaves are uniformly digested to the extent of about 80 per cent. Thus *neem* leaves can form a good green fodder supplement in summer when there is a great dearth of green fodder.

92. Morphology and Development of horns of the Coconut Fruit.

T. A. DAVIS, Kerala.

Coconut fruit bearing flat horns usually ranging from one to six is a rare phenomenon. There is considerable dispute regarding the correct morphology of these horns. Development of the staminodes, duplication of the gynaecial segments, apocarpic nature of the ovary and hypertrophy of the perianth parts are often attributed to be the causes for the production of horns in coconut. Sufficient specimens have been collected by the author which prove beyond doubt that morphologically horns are only analogous bodies and never homologous. It has been shown with examples that any floral part is capable of modifying into a horn-like structure. Two trees that constantly produce horned nuts, the morphology of the horns being the developed staminodes have been located, one at Kumbalam near Ernakulam and the other at Ayyapuram near Tenkasi (Tirunelveli District). Perhaps this character may be governed by hereditary factor(s) and some of the progenies of these trees are being studied. A rare tree producing fruits having two whorls of 3 + 3 carpels was located at Kayangulam where one or two or even all the three carpels of the additional whorl develop into horns. Apocarpic pistil and hypertrophy of the perianth parts have also been noticed in support of the respective theories on the development of horns.

93. "A preliminary study of dew and microclimate inside sugaracane crop."

P. S. SREENIVASAN, Poona.

Dew may be defined as moisture condensed from the atmosphere on exposed surfaces, cooled mainly by radiation below a temperature at which the water vapour present in the atmosphere is sufficient to saturate it. The phenomenon of dew is important because this plays not only a direct role in crop development especially in arid regions but also is held to be responsible for the incidence and intensity of many plant pests and diseases.

Systematic observation of dew in open and inside sugarcane crop was made at Poona during the months of September 1957 to January 1958. In the open dew was deposited more or less to the same degree on the dew gauges at all heights above 5 cms. where as inside the crop dew was formed only on dew gauges placed above the level of foliage. In the month of December, there was appreciably more dew over the crop than in the open.

The climatic factors controlling the intensity of the phenomenon are briefly examined in the paper. Also a graph showing the distribution of the temperature, humidity and dew in the open and inside crop on a typical day namely 23-11-1957 when dew was heavy, is presented.

94. Chemical composition, digestibility and nutritive value of *choti jargi (Chloris barbata)* grass-hay at the pre-flowering stage.

M. M. JAYAL, Izatnagar.

The hay gave the following percentage chemical composition, on dry basis :— crude protein, 5·950; ether extract, 1·367; crude fibre, 30·910; nitrogen-free extract, 49 843; total carbohydrates, 80·753; ash, 11·930; calcium, 0·736 and phosphorus, 0·074.

The hay was fed *ad libitum* to *kumaoni* bullocks as sole feed for 30 days, of which the last ten days constituted the collection period.

The average digestibility coefficients for crude protein, ether extract, crude fibre and nitrogen-free extract were found to be : 42·39, 60·55, 62 13 and 49·28 respectively. The percentage digestible crude protein and total digestible nutrients of the hay, on dry basis, were found to be : 2·52 and 48 15 respectively. The animals recorded positive retention of calcium, phosphorus and nitrogen and maintained their body weights. The results indicate that *choti jargi* hay in the pre-flowering stage forms a maintenance ration for bullocks.

95. Chemical composition, digestibility and nutritive value of *Bari Jargi (Dichanthium annulatum)* grass-hay at the pre-flowering stage.

M. M. JAYAL, Izatnagar.

The percentage chemical composition of the hay, on dry basis, was found to be : crude protein, 4 63; ether extract, 0·91; crude fibre, 38 88; nitrogen free extract, 46·10; total carbohydrates, 84 98, ash, 9·48; calcium, 0 865 and phosphorus 0·050.

To determine the nutritive value, the hay, supplemented with a requisite quantity of mustard cake, was fed *ad libitum* to *kumaoni* bullocks.

The average digestibility coefficients for crude protein, ether extract, crude fibre and nitrogen-free extract were found to be . 28·01, 29·24, 60 37 and 42·36 respectively. The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. of hay, on dry basis, were found to be : 1·30, 44 91 and 22·19 respectively. The animals displayed positive balances for nitrogen, calcium and phosphorus and maintained their body weights.

SECTION OF PHYSIOLOGY

President :—DR. N. P. BENAWARI, M.D.

Abstracts

1. Results of Fractional Gastric Analysis in Gastric Disorders.

M. L. PAI, Baroda.

Forty-six cases, admitted for complaints of gastric troubles, out of whom forty were males and six were females, of age varying between 16 and 66 years, coming from this part of the country, namely, Gujerat, were studied for their gastric secretory function by method of fractional gastric analysis after the alcohol and/or histamine meal test by the methods which were standardised and reported earlier. Out of the total of 46 cases, 9 gave achlorhydric response, 7 gave hypochlorhydric, 18 gave isochlorhydric and 12 gave hyperchlorhydric responses. The condition of ankylostomiasis was associated in 70% of the cases belonging to hypochlorhydric response, which was the highest incidence in this group when compared to the other groups. Thus ankylostomiasis is associated with a very low acidity of the gastric juice. This finding is in conformity with the similar finding already reported by the author. Histamine meal test confirmed true achlorhydria in 56% of the cases of achlorhydric group. From amongst the cases of the hyperchlorhydric response, fifty per cent cases showed the incidence of peptic ulcer. Blood was found to be present in the gastric samples in forty per cent out of these peptic ulcer cases. The percentage incidence of the presence of blood, bile, mucus, starch and lactic acid in the gastric samples in the cases of the above four groups separately has been shown in a tabular form in the paper. The results obtained above have been discussed in the paper and their significance has been emphasized.

2. Further observations on saltless diet.

J. S. SAKSENA and S. MAQBOOL AHMED, Hubli.

The present paper embodies further observations on the effect of saltless diet on blood pressure made during the last three years, supplemented by exercise tolerance studies on 25 volunteers kept on a saltless regime for 7 to 10 days.

Our studies lead us to the following conclusions :—

(1. It is further confirmed that increased salt consumption is intimately related to higher incidence of hypertension in modern society. If not the direct cause, it is at least an essential predisposing factor.

(2) Salt withdrawn, if abrupt, causes withdrawal symptoms like any other addiction. The severity of the symptoms increases with abruptness of withdrawal and degree of "addiction". This is why salt-abstinence is least acceptable to those who need it most. The harmful effects are most marked in the initial stages but disappear gradually with time.

(3) When cured of the "addiction" by prolonged abstinence—gradual or abrupt—the efficiency of muscular work increases and chances of developing high blood pressure become negligible.

(4) The hypertensive effects attributed to age, heredity and mental tension are at least partly due to increased salt ingestion.

(5) Addition of salt at table and not while cooking causes gradual increase in salt consumption.

(6) Breaking the salt-habit is not so difficult as it appears for salt abstinence is irksome only in initial stages.

Sodium is a high threshold substance. Its appearance in urine as a result of tubular reabsorptive maximum being exceeded. Excessive salt excretion in urine is associated with polyuria and polydipsia.

3. Effect of Atropine and Physostigmine on the Histamine-Induced Gastric Secretion of Dog.

B. S. KAHALI and B. B. MAITRYA, Jaipur.

Effect of Atropine and Physostigmine (each 0·1 mg/Kg) on the Histamine-induced (0·06 mg/Kg) gastric secretion in dogs with gastrostomy was investigated. It was observed that Atropine diminished the volume and acidity of the Histamine-induced gastric secretion, whereas, Physostigmine increased the acidity but decreased the volume (most likely due to increased motor activity of the gut) of the Histamine-induced gastric secretion.

It was concluded that the parietal cells posseses a tonic activity which is essential for the maximal response of Histamine. The tonic activity of parietal cells is dependent on parasympathetic supply and is thus depressed by Atropine and augmented by Physostigmine, causing modification of histamine-induced gastric secretion.

4. Effect of Sodium deficient Sucrose-Ringer on Mammalian Heart.

B. S. KAHALI and L. K. KOTHARI, Jaipur.

In the course of a study of the role of Sodium in the normal functioning of the heart, experiments were carried out on isolated rabbit auricles in which Sodium in the Ringer-Locke solution of the bath was replaced by iso-osmotic amount of sucrose.

0·72% Modified Ringer gave the maximum height of contraction, without any change in rate or rhythm. With 0·6 to 0·5% the contractions returned to the normal Ringer level or even below it. At 0·32% there was an increase in height followed by a marked fall. Na-free Modified Ringer quickly brought the heart to a standstll after an initial phase of increased height and frequency of contraction.

The results show that Na, to the extent of about 0·5% is essential in the Ringer's fluid for the normal excitability of the mammalian heart.

5. Electrical activity of the hypothalamic feeding centres under the effect of changes in blood sugar.

B. K. ANAND, S. DUA and BALDEV SINGH, New Delhi.

Hypothalamic regulation of food intake has been well established by now. Ablation and stimulation experiments have formed the basis for location of "feeding" centre in the lateral hypothalamus and "Satiety" centre in the medial hypothalamus. The mechanism of action of these centres has been explained by different workers on different bases, one suggestion being that this is a 'glucostatic' effect.

Electrical activity of these hypothalamic centres was recorded in conscious animals (cats and monkeys) through bipolar parallel electrodes implanted stereotaxically on an electroencephalograph machine. The recording was done both before and at 15 mts. intervals after intravenous injection of glucose or insulin on separate days. Blood samples for glucose estimations were also taken before each recording. Activity of 'feeding' centre was found to be slightly decreased after hyperglycaemia and increased after hypoglycaemia; whereas activity of 'satiety' centre was slowed after hypoglycaemia and increased after hyperglycaemia. No change in the activity of other hypothalamic and some cortical regions was observed as a result of changes in blood glucose.

A definite preponderance in the activity of left hypothalamus over the right hypothalamus was also observed.

Further experiments are being conducted to see the effects of changes in blood amino-acid and blood lipid content on the activity of these hypothalamic centres.

6. Histochemical studies in Hibernating Toad (Bufo Melanustictus).

M. MUKHERJEE and C. DEB, Calcutta.

Recently much importance has been attached to hypothermia due to its role in surgery. Hibernation resembles hypothermia in some aspects. For this reason studies were undertaken to observe the histochemical changes in a species (toad) which in our country hibernate during winter.

It has been observed that during hibernation (Feb) there is storage of neutral fat (sudanophilic) in the liver, intratubular spaces of testes and fat body. In summer (April) the organs are completely free from neutral fat but it begins to appear again during monsoon (August). Unsaturated lipides are poor during hibernation but they are present in gradually increasing amount in summer and in monsoon. The distribution of plasmologen is similar to that of unsaturated lipides. Periodic acid Schiff positive substance and α-amino acids are higher in liver, kidney and testes in non-hibernating state (April). DNA (Feulgen) is lower during hibernation but RNA (Pyronin) is higher under similar condition. During non-hibernation (April) the alkaline phosphatase activity of liver, testes and intestine is increased but there is a fall in kidney. Acid phosphatase in the tissues are increased during hibernation, lipase content of intestinue is decreased. The significance of these changes is discussed.

7. Differential Staining of Grey and White Matter in Spinal Cord and Cerebellum.

C. J. R. FRANCIS and C. DEB, Calcutta.

A method has been developed for the differential staining of grey and white matter in spinal cord and cerebellum.

The method essentially consists in fixing the tissue in a modified Carnoy (acetone-60, chloroform-30, acetic acid-10) fixative. It is dehydrated in acetone and sections are prepared in the usual way. The sections are then stained with a mixture of Leishman and Giemsa (5 :1) and afterwards treated with a 0·05 Molar acetic acid—sodium acetate buffer. It is washed in water, dehydrated in acetone and mounted in balsam. It has been observed that at pH 4·8 there is a differentiation in grey and white matter of cerebellum but not in spinal cord. The latter gave a differentiation at pH 6·5, but at this hydrogen ion concentration, no differentiation could be obtained in cerebellum. It may be possible that the isoelectric point of proteins of gray and white matter in spinal cord and cerebellum are different.

8. Observation on the behaviour of Toad's heart with distilled water, potassium-chloride and calcium chloride in perfused and unperfused intact heart.

B. K. CHAKRABARTI, Calcutta.

The effects of distilled water, 0·1% potassium chloride, and 0·1% Calcium chloride were compared between perfused and unperfused heart. In *perfused heart*, distilled water acts as a poison in stopping the heart; potassium chloride found to cause decrease in the rate with ultimate stoppage in diastole and Calcium chloride increased the rate and incomplete relaxation with ultimate stoppage in systole. In *unperfused intact heart*, direct application on the external surface by drops showed reverse effects as compared with the perfused heart. The muscle of the toad's heart receives nutrition from the blood circulating through the chambers. The contradictory observations points to the difference in the behaviour of permeability between the external and internal surfaces of the heart.

9. Artificial Rumen Fistula in Goat—A Preliminary Report.

A. K. CHOWDHURY, Calcutta.

A method has been described for making a permanent artificial rumen fistula in goat. The cannula which is fitted in the rumen consists of Alkathine tube 2½" long, about ¾" diameter fitted with a polythene fenestrated flange and polythine cap. The cannula is leak proot and can be used on any ruminant for studies on rumen physiology and digestion. Preliminary studies have been taken up on the rumen physiology and digestion in a Black Bengal Goat and the results are reported.

10. Influence of ions on the twitch tension of stretched and unstretched toad sartorius.

B. B. GHOSH and D. P. SADHU, Calcutta.

Effect of different concentrations of sodium, potassium, calcium and magnesium ions was tried on the isometric twitch tension of toad sartorius at 100%, 120%, 130% and 135% of the original length of the muscle in situ. It was observed that the tension change of muscle per unit change in potential (developed at the muscle—bathing fluid interface) in mV. was characteristic for the different ions. This value falls in potassium and magnesium and increases in calcium and sodium. On stretching to 120% tension decrease is characteristic of different ions, the decrease being minimum (12·7%) with magnesium ion and maximum (43·2%) with calcium ion, sodium and potassium changes being intermediate (22·1% and 39·3% respectively). At 130% length, decrease of tension was about 70%. The mechanism of these effects has been discussed with special reference to the mechano-coupling effect.

11. Electrical versus Chemical theory of neuro-muscular transmission.

INDRAJIT SINGH and A. K. ACHARYA, Agra.

On the basis of the differential effects of certain drugs and ions on the responses of certain plain muscles to electrical and chemical stimuli it has been surmised that neuro-muscular transmission is neither electrical nor chemical but electro-chemical.

BIO-CHEMISTRY & NUTRITION

12. Effect of $CdCl_2$ on the response of the genital organs of gonadectomized male and female rats to homologous sex hormones.

AMIYA B. KAR, J. N. KARKUN and R. P. DAS, Lucknow.

The stimulatory action of testosterone propionate on the seminal vesicle and the ventral prostate of castrated rats is inhibited by $CdCl_2$. The atrophy of the organs following castration is further attenuated by $CdCl_2$. These effects are specific and mediated through an alarming action of the latter on the adrenal cortex.

Similar opposing action is exerted by $CdCl_2$ on estrogen as shown by the response of the uterus of ovariectomized rats. However, $CdCl_2$ *per se* has no effect on the uterus. The adrenal cortex shows some indications of stimulation due to $CdCl_2$ treatment. The latter finding has some bearing on the mechanism of inhibitory action of $CdCl_2$ on estrogen.

13. Histochemical and Histological studies in normal and Aminopterin treated rats.

SACHCHIDANANDA BANERJEE and A. R. DRAVID, Calcutta.

Multiple congenital abnormalities resulting from a transitory deficiency of folic acid, and tissue changes, in rats were observed by various workers. There are numerous reports indicating the retarded synthesis of nucleic acids in folic acid deficiency. In the present communication are reported histochemical studies of alkaline and acid phosphatases, RNA and DNA in the liver, kidney, adrenal, spleen, pancreas, testes, ovaries, thyroid, and pituitary of normal and aminopterin treated rats. Histological studies of the above tissues were also undertaken.

The hematological study revealed significant diminution in the haemoglobin percentage, total leucocyte count, and the packed cell volume in rats receiving aminopterin. The alkaline phosphatase activity was significantly increased in the liver, adrenals, pancreas, and thyroid; and diminished in the pituitary of aminopterin treated rats as compared with the normal controls. The acid phosphatase activity was found to be significantly increased in the liver, adrenals, spleen, pancreas, and thyroid; and diminished in the pituitary of aminopterin treated rats as compared with the normal animals. Testes and ovaries of both normal and aminopterin treated rats showed a negative reaction for acid phosphatase. The RNA and DNA showed a significant diminution in liver, pancreas, adrenals and spleen of the aminopterin treated rats as against the normal controls. Macroscopic observations of the treated animals revealed distended stomachs, shrunken spleens, enlarged adrenals and pale livers. The haematoxylin and eosin stained sections on microscopic observation showed changes in spleen and liver of the treated rats.

The phosphatases are presumed to play an important role in the metabolism of carbohydrate, lipids and nucleo-proteins, though their exact mechanism of action is still obscure. Hence the changes observed here indicate only the altered physiological function of the organs. The suggestion of Moog and Dempsey and Wislocki that adrenal alkaline phosphatase plays an important role in the metabolism of lipoids and so possibly in the synthesis of adrenal cortical hormones; and the report of Dougherty *et al* that aminopterin has a hormonally mediated effect, deserves attention in the light of the observations reported here. The diminished RNA and DNA contents in aminopterin treated rats seem to be a direct consequence of folic acid deficiency, as the role played by folic acid in nucleic acid synthesis is fairly established.

14. Adrenocortical function in some mental diseases.

DHIRENDRA NATH NANDI and SACHCHIDANANDA BANERJEE, Calcutta.

Eosinopenic response to injected epinephrine was studied in patients suffering from schizophrenia (26), paranoia (21), depression (10), and mania (15). 15 normal subjects were also similarly studied. Eosinopenic response was lower in cases of schizophrenia and mania, higher in depression and normal in paranoia. 24-Hour urinary excretion of 17-ketosteroids which was studied in 8 schizophrenic patients was very low. Chorionic 'gonadotropin therapy was found to improve the mental state of schizophrenics who excreted lower quantity of urinary 17-ketosteroids.

15. Estimation of R.B.C. Life by 'in vitro' and 'in vivo' Tagging with Cr^{51}.

FAZLE HOSEIN and PARVATHI HOSAIN, Calcutta.

Estimation of R.B.C. life has been carried out using low dose of Cr^{51} and low level counting technique. Two methods of tagging the R.B.C. have been adopted : (i) in-vitro, by mixing the blood and the isotope under asceptic condition, (ii) in-vivo, by injecting the isotope directly into the vein. In both the cases radioactive chromium as sodium chromate has been used. Bi-weekly assay of the radioactivity of the blood is then carried out for about six weeks. A limited number of normal cases has been completed and the R.B.C. life-span has been found to vary from 96-122 days. The average result obtained by in-vitro method is lower compared to in-vivo method.

16. Endocrines and the Stunted Youngsters.

S. H. MARATHAY, Bombay.

Boys and girls in their own age-group of 14 and 16 if short in height, should be considered as "Stunted" and should be treated with Endocrine Therapy. The age of choice for best results in boys is 15 to 16, and in girls it is 13 to 14 years. The Epiphyseal lines at these ages are wide enough (5 to 6 mm.) and respond to treatment very well. Though the epiphyseal lines are seen clearly later, they are too weak to be helped by stimulation, to expect some desirable results. Results are cited of two typical cases of boys treated at age 15 and 16, have shown remarkable results, giving an increase in height from 6″ to 7″ or 15 cms. to 17·5 cms., with proportionate addition in weight from 6 to 8 kilos or more.

The preparation used throughout was "Ambinon A" injections (intra-muscularly) of Organon Laboratories of London. This Anterior Pituitary preparation does not produce any undesirable effects on Thyroid, even though the latter was additionally given orally for 3 months. It is concluded that Ant. Pituitary can be stimulated for growth factor, in stunted youngsters at proper age, without any harm.

17. Cholinesterase in decentralised and axotomised sympathetic ganglia.

S. K. DHAR, Calcutta.

The cholinesterase activities of the superior cervical ganglia of rats have been investigated, with a view to explain the cause of the failure of transmission of impulses through the ganglia, on preganglionic stimulation, in axotomised animals.

Male rats of similar weights were used in each experiment. Estimations of ChE activities were carried out manometrically with a Warburg's apparatus, at a pH of 7·4 and a temperature of 37°C. Acetyl β methyl'choline chloride and Benzoylcholine chloride were used as substrates for the true and pseudo ChE respectively. Results were expressed in μl of CO_2 evolved per hour per ganglion.

At first the values for the normal ganglia of the right and left sides were determined separately. With aseptic precautions, section of the cervical sympathetic trunk was then done in some groups of animals, on the right side, and section of the post-ganglionic fibres (axotomy), in some other groups. After 2 to 3 weeks, the animals were killed, the ganglia removed, decapsulated, homogenised in distilled water and the ChE activities estimated in the same way. Left ganglia were used as controls to give the normal values.

It was found that after sectioning the pre-ganglionic or the post-ganglionic fibres, there is a loss of about half the amount of ganglionic true ChE. The loss of pseudo ChE was however much less.

18. Physiology of Fluid Exchange and Electrolyte Balance in the tropics during summer.

M. S. MALHOTRA, New Delhi.

In the tropics, where the environmental temperature is higher than that of skin, the heat is gained by conduction, convection and radiation from the surroundings. The only effective method of losing heat and keeping thermal equilibrium of the body is by evaporation of sweat. The losses of water and salt in sweat at different environmental temperatures have been worked out. It has been found that the sweat loss increases by 17 gm./hr. and the salt loss in sweat by 0·032 gm./hr. for every °F rise in D.B. temperature in the range 95°F to 113°F. On this basis the salt requirement for a person engaged in 8 hrs. work, when maximum temperature of the day is 110°F has been assessed as 14·5 gm./day and the water requirement to be about 9 litres/day. These results have been confirmed in field on naval ratings, in textile industry and on soldiers. It has been concluded that salt intake of the normal Indian dietary is quite enough for summer and it is not necessary to take salt periodically in fluid drinks. Further to keep the body in fluid balance during work in summer, water must be taken every hour.

19. Role of Adrenal Cortical Homones in Allergy : Part I—Release of histamine after injection of some common drugs including organometallic compounds.

B. N. CHOWDHURI, Calcutta.

'Reactions' in patients are often encountered after injection of certain drugs including some organometallic compounds. These so-called reactions are considered to be allergic in nature and are observed in certain percentage of cases considered to be susceptible to particular drug. Reactions of this nature are frequently observed with organic antimony compounds and to a less extent with organic arsenical compounds. Intravenous injection of such compounds in anaesthetised cats was observed to cause delayed (not immediate) fall of carotid blood pressure. The degree of such fall of blood pressure was also observed to vary from animal to animal presumably depending on the susceptibility of the animal. In order to find out whether this delayed fall of blood pressure was due to release of histamine in circulation, plasma histamine content was determined before and after injection of such drugs on atropinised guineapig's ileum and on blood pressure of another cat. Increase of plasma histamine content was observed after injection of drugs like urea stibamine, neostibosan, anthiomaline, stibophen, stibatin, neoarsphenamine, stilbamidine, morphine and d-tubocurarine, showing that these drugs cause release of histamine.

20. Role of Adrenal Cortical Hormones in Allergy : Part II—Adrenal cortical hormones and release of histamine after injection of certain organometallic compounds : Preliminary observations.

B. N. CHOWDHURI, Calcutta.

Release of histamine in circulation was observed after injection of compounds like urea stibamine, neostibosan, anthiomaline, stibatin, neoarsphenamine, morphine, stilbamidine and d-tubocurarine in anaesthetised cats causing delayed fall of blood pressure. Injection of glucocorticoids and ACTH just before injection of such drugs failed to check release of histamine. However, repeated injection of glucocorticoids or ACTH for a number of days was observed to modify the action of the previously mentioned drugs on cat's carotid blood pressure, the range of fall being definitely less than observed in animals unprotected with previous injection of glucocorticoids or ACTH. Plasma histamine content, as determined on atropinised guineapig's ileum and on blood pressure of another cat, was also definitely less than expected and in some cases almost normal as before injection of histamine liberators. This shows that repeated injections for a few days of glucocorticoids or ACTH prevents release of histamine after injection of histamine liberators The possible mechanism of such action has been discussed.

21. Role of dietary protein and methionine on blood cholesterol level.

KALYAN BAGCHI, Calcutta.

Hypercholesterolaemia is a concomitant finding in atherosclerosis and coronary diseases. A considerable amount of work has been done in recent years to correlate diet with these diseases. Most investigators in this line are concerned with the role of dietary fat—both quantitative and qualitative—in cholesterogenesis and it is generally agreed that dietary fat and essential fatty acids control to a large extent, the serum cholesterol level.

The role of dietary protein in such function has generally been overlooked. There are strong epidemiological, clinical and biochemical evidences to show such.

In the present investigation, it has been shown that rats on a low protein diet at 4 per cent level have a significantly lower serum cholesterol level in comparison to the control animals. Supplementation of the low protein diet with 50 mgm. methionine daily, raises the cholesterol level by about 35 per cent in 30 days. Similarly, administration of methionine sulphoximine an anti-metabolite of methionine to rats on high protein diet produced a significant lowering of cholesterol level in 15 days.

22. Effect of Thyroid on Gastric Secretion in Dog.

B. S. KAHALI and B. B. MAITRYA, Jaipur.

Effect of feeding desicated thyroid extract-8 mg. daily for 8 days on histamine induced gastric secretion was studied in healthy dogs with gastrostomy. Gastric secretion was induced by 0·06 mg./Kg. of Histamine acid phosphate subcutaneously before and after thyroid feeding. Half an hour Histamine-induced gastric secretion was estimated for quantity, free and total Hcl and total chloride. Serum sodium, potassium, and chloride were estimated before and after the therapy.

The gastric acid and secretory response were diminished after thyroid medication, and there was no appreciable change in other values. Most likely this effect was due to non-Thyroxine gastric factor of thyroid (Watman & Nasset., 1951).

23. Studies on effect of stress on Adrenaline, Sodium and Potassium arterial blood levels in men and dogs.

B. S. KAHALI and K. P. KHUTETA, Jaipur.

Effect of exposure to cold and abdominal operations on Sodium and Potassium levels in blood of dogs and men has been investigated by direct Flame Photometry.

In dogs both stresses induce a fall of Potassium and a rise of Sodium levels indicating hyperaldosteronaemea.

In man exposure to cold causes a definite rise of Potassium and slight rise of Sodium levels. The rise of potassium is difficult to explain but is likely due to simultaneous mobilisation of glucose due to adrenaline. Abdominal operations showed two characteristic patterns, according to the presence or absence of metabolic alkalosis preceding the operation. In uncomplicated abdominal operation without any preceding alkalosis—the Sodium level shows a decline and potassium a slight rise, similar to that caused by exposure to cold as used in this investigation; while with metabolic alkalosis the reverse findings, have been found—a rise of sodium and a fall of potassium. The probable causes of this discrepancy have been discussed.

Both stresses induce a rise of arterial blood adrenaline level as estimated by a modified de Jalon's technique on rat's uterus.

24. Some protective action of Vitamin A upon the ill effects of growth rate and survival period of the animals consuming heated fat ration.

D. SINHA and P. B. SEN, Calcutta.

Extensive studies have been made by different investigators upon numerous changes that a fat undergoes when exposed to high temperature. Such physico-chemical alterations of fat may have some effect on the nutritional status of the animals. In the present experiment the effect of dietary heated fat upon growth rate and survival period of the animals have been studied. Vitamin A has been reported to be destroyed in vitrowhen added to heated oil, and animals consuming heated fat diet were also reported to develop vitamin A deficiency symptoms. In the present study attempts have been made to investigate whether extra supplement of vitamin A over normal doses, could protect the animals from the observed ill-effects upon normal growth rate and longevity period of the animals.

The animals consuming diet with sesame oil, mustard oil or cocoanut oil heated at 350°C for 3 hours at a level of 20 per cent, suffered a great loss in weight. When the experimental animals were reversed to isocaloric control diet containing unheated fat they resumed normal weight gain. Higher mortality rate was also noted in experimental groups. Extra supplementation of vitamin A seems to have beneficial effect on both growth rate and survival period of the animals. The highest dose of 250 I.U. per day delayed the effect of heated fat ingestion but could not totally counterbalance the ill-effects. It has been suggested that factors other than vitamin A depletion may be also responsible for the observed changes.

25. Serum protein changes during Hypothermia with special reference to changes induced by Antihistamine drug.

ANUBHA CHOWDHURY, B. N. KOLAY and P. B. SEN, Calcutta.

The cats were anaesthetised. Arterial and venous blood sugar level, total serum protein and its different fractions were estimated at normal body temperature. A dose of antistine was then injected intramuscularly and hypothermia was induced by surface cooling till the rectal temperature came down to 25°C. Arterial and venous blood sugar level, total serum protein and different fractions of serum protein were estimated at this hypothermic condition of the cat.

It has been noted that in hypothermia arterio-venous difference in blood sugar is much smaller in these antistine injected cats. In cat where antistine was not injected arterio-venous difference in blood sugar during hypothermia was higher. Serum protein content either remained at the normal level or decreased to a small extent in antistine injected cats. Albumin/globulin ratio did not decrease.

The role of histamine in increasing the permeability during hypothermia induced in cat has been discussed.

26. An electrophoretic study of the adrenal gland of rats exposed to cold.

B. M. ROICHAUDHURI, ANUBHA CHOWDHURY and P. B. SEN, Cacutta.

Paperelectrophoretic studies of the cytoplasmic component of the adrenal glands of rats have been made. It has been observed that rats maintained in a cold environment (8° ± 1°C) for 24 and 48 hours show a greater concentration of cytoplasmic proteins and lipoproteins than the normal ones.

The proteinograms of the cytoplasmic constituents of adrenal glands in normal rats show two major peaks, A and B and the changes of the pattern of these peaks have been noticed after 24 and 48 hours of cold exposure. Similarly the changes in the pattern in the lipoproteinogram have also been observed.

27. Study on the rate of glycogenolysis in liver slices after two months of lactose feeding in albino rats.

ANUBHA CHOWDHURY and D. P. SADHU, Calcutta.

Albino rats weighing about 35 gms. were divided in two groups. Group 1 was given a lactose-free diet and group 2 the same diet excepting for a partial replacement of sucrose by 20% lactose. After two months of feeding rats of each group were sacrificed and rate of glycogenolysis in liver slice was studied in a sugar-free medium of Krebs Ringer phosphate buffer (pH 7·4) at 37°C. It was noted that the rate of glycogenolysis in liver slices was slower in rats of group 2 than that of group 1. This explains the slowing of glycogen breakdown in lactose-fed rats.

28. Isolation of the substance present in the faeces of pregnant cows which on injection to male toads causes ejaculation of sperms.

J. K. MOHANTY, Cuttack.

It was reported before by the author as well as other workers that an aqueous extract of the faeces of pregnant cows on injection to male toads causes ejaculation of sperms. Naturally enough it was presumed that a substance is present in the faeces of pregnant cows which possesses this biological property. Therefore, an attempt was made to isolate this substance. In the present paper a method is described by which the unknown substance has been successfully isolated in impure form. Work is in progress to purify the substance and study its biological and physico-chemical properties.

29. Thyroid and Vitamin E on Experimentally cryptorchid and infrared exposed testes.

A. K. CHOWDHURY and P. B. SEN, Calcutta.

Artificial cryptorchidism for one month in guineapig caused complete degeneration of all the germinal layers of the testes. Infrared exposure had a similar effect. Treatment with thyroxine, methyl thiouracil or vitamin E could not protect the germinal epithelium. In thyroxine treated animals there was a significant increase in leydig cells. Peritubular fibrosis of the seminiferous tubules was seen in some cases. Methyl thiouracil treated animals showed complete degeneration of both leydig cells and germinal cells. Peritubular fibrosis was more prominent. Vitamin E treated animals showed same type of reaction as thyroxine treated animals. Infrared irradiation only caused a more severe type of degeneration and some leydig cells also showed degenerative changes. It is most probable that both in the case of hyperthyroidism or hypervitaminosis E there is stimulation of ICSH secretion from the pituitary while hypothyroidism inhibits this.

30. Respiration of tissue slices in hypothermia.

D. P. SADHU, Calcutta.

In the first series, liver and kidney slices of rat, sparrow and toad were used. $Q\ O_2$ of the slices was measured with succinate and acetate substrate at 38°, 28° and 18°C in warburg manometers. Rat tissue slices showed a Q_{10} value of about 2, sparrow tissues a value of about 0·5 in liver and 0·7 in kidney, while toad tissues showed a value of 0·3 in liver and about 2 in kidney for the temperature fall to 28°, but there was no more fall in $Q\ O_2$ value from 28° to 18°C. In the second series, rats, sparrow and toads were put in a cold room at 20°C for one week after which they were sacrificed and their tissue slices examined in warburg manometers at 38°C and compared with the slices from animals at room temperature. Although there is compensatory increase of metabolism *in vivo* when exposed to low ambient temperature, there is lowering of $Q\ O_2$ value in both liver and kidney slices in rat with succinate and ascorbate substrates, but there was an increase in $Q\ O_2$ value in the sparrows by 12 to 53%, while in toads there is an increase of more than 100%. It is expected that toad would go to hibernation at low temperature and $Q\ O_2$ would fall, but this behaviour of poikilotherms is really observed when the ambient temperature is about freezing. These results indicate that birds form an intermediate link in the evolution of homeothermy from the poikiotherms and the usual classification of animals into homoiotherms and poikilotherms is not strictly valid.

31. Galactose oxidising and glucose oxidising enzyme levels in R.B.C.s and in liver after lactose feeding.

ANUBHA CHOWDHURY and D. P. SADHU, Calcutta.

Galactose oxidising capacity increases in R. B. Cs. of rats receiving 20% lactose in diet (group 2) after one and half months of feeding. After six months of feeding the increase of galactose oxidising capacity is less in R.B.Cs. of rats receiving 40% lactose in diet (group 3) compared to that in group 2 though the value of galactose oxidation in R.B.Cs. in both groups is significantly higher than that in the sucrose fed controls (group 1). Effects are similar with liver homogenates from rats of the above three groups. These results indicate an adaptive increase of galactose oxidising enzyme activity in R.B.Cs. and in liver after a long period of lactose feeding in rats. After six months of feeding glucose oxidising capacity decreases in R.B.Cs. and in liver of rats of group 2 and such decrease is still greater in rats of group 3.

32. Effect of Hypervitaminosis A on the oxidation of Succinate and ascorbate by liver tissue of rat.

AMAL RAY and D. P. SADHU, Calcutta.

The succinoxidase activity of the liver tissue of hypervitaminotic A rat is inhibited significantly in comparison to that of the untreated control. The ascorbic acid oxidase system, on the other hand, in the same tissue is not so much affected. The results are expressed as microlitres of oxygen uptake per miligram of nitrogen per hour. It is found that after 10 to 12 days treatment of Vitamin A as Arovit to the albino rat (30,000 I.u./day/rat), the oxygen uptakes per hour per mgm. nitrogen of tissues are 168 and 198 in the treated and control groups of rats respectively when Na-succinate is used as substrate. In the case of Na-ascorbate as substrate it is found to be 206 and 218 in treated and Control rats respectively. The percentage of inhibition is 15 and 6 after one hour when the substrate is used as Na-succinate and Na-ascorbate respectively. The main inhibition of tissue respiration in liver appears to be in the succinic dehydrogenase system. The depressor activity in the liver plays an important part in the decrease in energy metabolism of the body.

33. Studies on the hyperthermic responses in Baby Rabbits. (1) A study of the mechanism of increase of blood sugar in hyperthermia.

S. C. CHOWDHURI and D. P. SADHU, Calcutta.

Baby albino rabbits weighing from 220-330 gms. were incubated in one group at 42°C for 1 and ½ hr. and in other group at 45°C for the same period. Increase in rectal temperature has been noticed to have direct relationship to the increased environmental temperature. The normal rectal temperature of the rabbits varied from 37·5°—39 5°C. After incubation at 42°C for 1 and ½ hour the rectal temperature was increased by 1·5°—2·3°C and after incubation at 45°C for the same period the rectal temperature was increased by 2·2° to 2·7°C. Blood sugar level was significantly increased in hyperthermia, while no variation in the hematocrit value has been obtained. The normal blood sugar level was 65·7±6 mg. per 100 c.c. of blood. After incubation at 42°C for 1 and ½ hour the blood sugar level was increased by 22 to 49 mg.% and after incubation at 45°C the blood sugar level was increased by 28 to 55 mg.%. After injection of sympatholytic drug such as ergot amine tartarate, the blood sugar level did not show any significant rise in hyperthermia. This indicates that the thermoglycemic response in baby rabbits is adrenergic in nature.

34. Studies on Pulse Proteins : Part II. Nutritive value as influenced by genetic constitution and environments.

G. C. ESH and T. S. De, Calcutta.

The digestibility and biological value of high protein and low protein Bengal gram were estimated by feeding rats diets containing pulses as the exclusive source of protein. The results tend to indicate that the digestibility increases and biological value slightly decreases along with the increase of protein content of Bengal gram when raised from different stains and environments. The growth promoting value of both high protein and low protein Bengal gram was assessed by feeding diets containing pulses as the exclusive source of protein as well as after supplementation with wheat and casein. The data tend to show the following trend :

(a) High protein Bengal gram when fed in raw state at 12% protein level shows higher protein efficiency ratio.

(b) When fed along with wheat as the supplemental protein (wheat supplement contributing 5% protein in the diet both the high protein and low protein Bengal gram maintain about equal protein efficiency ratio at 12% protein level.

(c) When casein as a protein supplement was added to diets containing a constant proportion of Bengal gram of high and low protein content equalising the protein content at 18% the results show the superior nutritive value of high protein pulse.

The above results thus tend to show that the increased protein induced as a result of stain difference and/or environmental variation is in no way inferior to the low protein pulses in nutritional quality and in some cases rather superior.

35. Studies on the Nutritive Value of Enzymatic Protein Digest : Part III. Influence of Degree of Hydrolysis on the Nutritive Value.

G. C. ESH and S. K. GANGULY, Calcutta.

Meat and casein were hydrolysed with, papain to obtain protein hydrolysates at varying degrees of hydrolysis by attending the concentration of the enzymes and time of digestion. The enzymic digests were further digested into acid to raise the degree of hydrolysis. These digests were fed to protein depleted adult rats as an exclusive source of protein to observe their efficiency in protein regeneration. The results tend to indicate that in case of casein hydrolysates there is no significant difference in the utilization of amino acid—peptide mixture of the digests at varying degree of hydrolysis although the protein efficiency ratio of the digests is always a little lower than that of the intact casein. In case of meat hydrolysates, however, highest protein efficiency ratio has been observed for the digest at 46-48% degree of hydrolysis indicating a pattern of amino acid peptide mixture most effective in their utilization. The possibility of early absorption of amino acid complexes from the duodenum has been discussed.

36. On the Estimation of Pentose- and Desoxypentose-Nucleic Acid in Ox Liver.

S. K. DUTTA, Calcutta.

Total nucleic acid of ox liver has been isolated by simple mild method, comprising the dissociation of the nucleoprotein with subsequent adsorption of the basic protein with a cation-exchange resin and the precipitation of the residual protein with chloral hydrate. The nucleic acid remaining in the mother solution was then fractionated into PNA and DPNA with cetrimide and purified with ethanol in presence of Ca++. The PNA and DPNA were then analysed for their contents of purines and pyrimidines in moles per 100 g. atoms of phosphorus. Crude ox liver was directly hydrolysed and chromatographically analysed for its content of uracil and thymine, from which the respective amounts of PNA and DPNA were calculated. Other usual methods of estimating PNA and DPNA in tissues, according to Schmidt and Thannhauser and Schneider, have been critically examined and their advantages and disadvantages discussed.

37. A preliminary note on the histamine content of Liver Extracts.

A. N. BOSE, B. K. BOSE and SRIPATI BOSE, Calcutta.

Injections of liver extract, as available in the Indian market, are commonly observed to lack uniformity of standards as regards physico-chemical and biological characteristics. Though a number of specifications are laid down in some pharmacopoeias, no biological test are laid to ensure freedom from untoward reactions likely to be caused by histamine contamination of the products. A preliminary investigation has, therefore, been carried in this laboratory to estimate the histamine content of different types of liver extract, as available in the market, using the atropinised guineapig ileum method comparision were made with a standard solution of pure histamine diphosphate. A four-point assay design, based on two doses of standard and two doses of test in equivalent ratio, and consisting of 24 contractions, was followed to arrive at the values of histamine by statistical methods.

The results of the investigation show that samples of purified, fractionated and concentrated liver extracts are devoid of any detectable contamination with histamine. But the amount of histamine present in crude liver extract is considerable though varying in different samples (7·9 to 27·9/ml.). Proteolysed whole liver extracts however show comparatively low content of histamine 3·6 to 4·3/ml.).

38. "An Experimental Study of Relation between Vitamin A and Thyroid Activity".

J. N. PRASAD, Lucknow.

The present sets of experiments have been done to study the alleged antagonism of thyroxin to vitamin A.

The observations have been made in 3 sets of rats of 6, 12 and 12 weeks duration. First two sets were divided into three groups while the 3rd set was divided into 2 only.

First group of the 3 sets was given Vitamin A as much as 25,000, 50,000 and 25,000 I.U. on alternate days.

Second group of all the sets was given Eltroxin (Thyroxin) 0·01 mgm., 0·02 mgm. and 0·01 mgm. on alternate days.

Third group of the first two sets was given Vitamin A and thyroxin combined. Every week weight of each rat was recorded and one rat from each group was sacrificed and thyroid examined histologically.

Results :

Rats getting Vitamin A :

1. Thyroid shows hyperactive changes.
2. There is steady gain in weight.
3. No Toxic manifestations (loss of appetite falling of hair etc.).

Rats getting thyroid :

1. Thyroid shows hypoactive changes.
2. Loss of weight in the first two sets and gain in weight in the 3rd set.
3. No toxic manifestations.

Rats getting Both :

1. First set shows hypocactive changes and second set hyperactive.
2. Steady gain in weight.
3. No Toxic manifestations.

39. Accuracy of Fantus Test in Estimation of Urinary Chlorides.

M. S. MALHOTRA, New Delhi.

The estimation of chloride content of urine is the most important test for finding salt deficiency in the body. For rough and easy estimation "Fantus test" is used, in place of more accurate and comparatively difficult titration methods. Recently it has been suggested that this test is not a reliable one.

In the present paper the results of chloride estimation in urine by Fantus test and by titration methods have been compared. A total of 210 urine samples, with chloride concentration ranging from 1·8 gm./litre to 23·3 gm./litre have been analysed. It has been found that the values for the two tests are closely related to each other and those for Fantus test are slightly higher. It has been concluded that if the urine chloride concentration is 5 gm./litre or more by this test, there is very little possibility of salt deficiency existing in the body. If the values are less than 5 gm./litre, more accurate methods should be employed for estimation of chlorides.

40. Physiological significance of Inositol, Vitamin B_{12} and Glucose-Cyclo-Aceto-acetate in Cholesterol induced Atherosclerosis of Rabbits.

M. C. NATH and A. SAIKIA, Nagpur.

Inositol, vitamin B_{12} and glucose-cyclo-acetoacetate (GCA) both hydrolysed and unhydrolysed have been found to check the rise of total cholesterol, ester cholesterol and C/P ratio in the serum as well as in the liver and kidney of cholesterol fed animals, the effect being the most pronounced in case of GCA (hydrolysed) injected group.

In liver and kidney, the effect of GCA, both hydrolysed and non-hydrolysed, has been found to be much more pronounced than that of inositol and vitamin B_{12}.

Inositol has also been found to depress the phospholipid contents in serum, liver and kidney of cholesterol fed animals but the effect is not so much as with vitamin B_{12} and GCA (hydrolysed).

Free cholesterol/Total cholesterol (i.e. F/T) ratio which is usually low in hyperlipemia and atherosclerosis, has also been found to be high in case of animals given cholesterol supplemented diet and treated with GCA (hydrolysed) and corresponding more or less to the normal values.

Inositol and GCA (hydrolysed), like vitamin B_{12} have been found to increase the methionine contents of the liver. The gain in body weight has been the highest in the animals of group V (i.e. injected with GCA hydrolysed).

The iodine values of the liver fat of the cholesterol fed animals treated with inositol, vitamin B_{12} and GCA are much higher than those of animals given cholesterol supplemented diet only.

41. Studies on the synthesis of Glucose-Cyclo-Acetoacetate and Biosynthesis of Ascorbic Acid in germinating Mung Beans (Plaseolus Radiatus).

M. C. NATH and M. L. BELKHODE, Nagpur.

Glucose-cyclo-acetoacetate (GCA) which is a precursor of ascorbic acid in the germinating legumes and which on hydrolysis gives rise to a reducing dienol glucose, has been shown to be formed during the process of germination from glucose and acetoacetate. Thiamine and Pantothenic acid have been found to accelerate the biosynthesis of GCA and their antivitamins have been shown to depress such synthesis. GCA has thus been shown to be an intermediary product towards the biosynthesis of ascorbic acid during the process of germination of legumes.

42. Cure of Alloxan Diabetes by combined therapy with Glucose-Cyclo-Acetoacetate and Estrogen.

M. C. NATH and E. P. M. BHATTATHIRY, Nagpur.

Alloan Diabetes in rabbits was ameliorated or cured by daily repeated intramuscular injections of glucose-cyclo-acetoacetate (GCA) as the sodium salt and estrogen (estradiol monobenzoate, R.D.H.). The effect was more pronounced when GCA was hydrolysed prior to administration. The cured animals were found to be normal in all respects.

Neither GCA (or its hydrolyzed product) nor estrogen effected completed cure of alloxan diabetes in rabbits within the observation period of 8 weeks when one was administered without the other.

This curative effect may be explained by postulating synergism between GCA (or its hydrolyzed product), which has previously been shown to spare glutathione and estrogen, which has been reported to activate hexokinase.

43. Studies on the metabolic role of medicinal (Ayurvedic) Calcium preparations. Part II. Their effect upon blood calcium and related constituents.

D. B. MOTLAG and M. C. NATH, Nagpur.

The effect of medicinal calcium preparations from pearls, corals and conch shells and calcium carbonate and lactate upon blood components like calcium, inorganic phosphorus proteins and alkaline phosphatase activity has been studied and their relationship discussed.

It has been observed that the plasma calcium level and plasma inorganic phosphorus level are inversely related to each other in all the groups. The ionic product Ca×P has been found to be suitable for calcification of bones in all the groups studied, the highest value being observed in group No. I, where pearls were used as the calcium source.

The effect of all the calcium preparations on plasma proteins to form calcium complex and on the percentage of free (Ca^{++}) ions upon calcification has been discussed.

The plasma alkaline phosphatase activity is found to be almost normal in the groups given pearls and corals while it is higher in rest of the groups.

The blood coagulation time is found to be within a narrow range in all the groups.

44. Effect of Acetoacetate on the Adrenaline content of the Adrenals of normal and scorbutic Guinea-pigs.

S. G. NAYUDU and M. C. NATH, Nagpur.

The possibility of the stimulation of the adrenal medulla as one of the factors for acetoacetate induced diabetes, has been examined. The size and adrenaline content of the adrenals has been found to be increased in scurvy. Repeated daily injections of acetoacetate have been observed to cause an increased secretion of adrenaline both in normal and scorbutic guinea-pigs. Single injection of Acetoacetate, however, does not show any appreciable increase in the adrenaline content of the adrenals. The weights of adrenals are not affected by acetoacetate injection either single or repeated.

PHARMACOLOGY

45. Quinoline-thiazolidine compounds as histamine-antagonists.

J. K. MOHANTY, B. N. DAS and B. SAHOO, Cuttack.

Twelve compounds which were synthesized by condensing thiazole and quinoline rings with various groups linked to different positions were screened for possible antihistaminis activity. All the compounds are practically insoluble in water and only sparingly soluble in ethyl alcohol. Blockade of histamine-induced contraction on guinea-pig ileum and prevention of blood pressure lowering action of histamine on anaesthetized dogs were used as the test methods. Relative antihistaminic potency was studied on guinea-pig ileum by using Antazoline hydro chloride (Antistine) as the reference standard drug. Calculations were made by probit analysis as advocated by Chen et al. All the compounds exhibited significant antihistaminic activity. Compound M57-BB (Code number) was the most potent of the series studied. It seems to be slightly stronger than Antazoline hydrochloride. Five compounds of this series including M57-BB also exhibited anti-acetylcholine activity. Further work on these compounds are in progress.

46. Antihistaminic activity of 2 (O)-Chloro-phenyl-amino-4, 5,-Quinoline Thiazoline (M51-BB).

J. K. MOHANTY, B. N. DAS and B. DAS, Cuttack.

In course of testing newly synthesized thiazole derivatives for useful pharmacological properties, the compound 2 (o)-Chloro-phenyl-amino-4,5,-quinoline thiazoline (Code name M51-BB) was found to be a potent histamine antagonist. Therefore, it was picked up for further study.

This compound exhibited strong antihistaminic activity as judged from results of various standard experiments performed for evaluation of antihistaminic property. Prevention of contraction of isolated guinea-pig ileum induced by histamine and blackade of histamine-induced hypotension in dogs as well as its protective action against lethal intravenous doses of histamine in guinea-pigs were studied. The relative antihistaminic potency of the compound was studied on isolated guinea-pig ileum using Antazoline hydrochloride (Antistine) as the reference standard. Acute toxicity of the compound was studied on guinea-pigs. It seems, as an antihistamine, this compound is four times as potent as Antazoline hydrochloride which is widely used in clinical practice. The acute toxicity of the compound on guinea-pigs seems to be low and compares very favourably with that of known antihistamimic drugs. The compound also exhibited good antiacetylcholine action. Further study is in progress.

47. A study on the antiveratrinic action as a common property and method of screening antiarrhythmic drugs.

R. B. ARORA and P. L. SHARMA, New Delhi.

An analysis of the antiveratrinic and antiarrhythmic activity of 42 compounds reported so far, show that substances which produce a beneficial effect in atrial arrhythmias also possess antiveratrinic action. No definite correlation exists between the antiveratrinic and antiarrhythmic activity of drugs effective in ventricular arrhythmias. Both the antiveratrinic and quinidine-like action has been seen not to depend upon any definite chemical configuration. The effect on refractory period cannot explain the antifibrillatory action of all the drugs effective in atrial arrhythmias viz. emetine and procaine which neutralize fibrillation do not influence the refractory period at all but they do possess an antiveratrinic action in conc. of 1 :100,000 and 1 :30,000 respectively. In our experiments potassium in a conc. of 1 :5,000 has been found to antagonize veratrine response and by increasing the potassium content of the bath fluid to one and one half times the normal the antiveratrinic action of quinidine, chloroquin, camoquin, plaquenil, pamaquin, isopentaquin, daraprim, mepacrine and paludrine could be elicited in lower concentrations. Plaquenil and isopentaquin has been found to be more effective than quinidine in atrial arrhythmia. Further it has been found that a generalised antagonism to acetylcholine is not essential for the antiveratrinic and antiarrhythmic activity of drugs. It has been concluded that drugs which produce a beneficial effect in atrial arrhythmias also possess antiveratrinic action and that the antiveratrinic activity may be safely utilized as a screening procedure for antiarrhythmic drugs.

48. Effectiveness of Khellin as a Human Spermicidal agent and as an oral Contraceptive.

R. B. ARORA and K. N. SAXENA, New Delhi.

Antifertility studies were carried out with Khellin (isolated from Ammi visnaga), on 37 specimens of human semen and a group of animals. Khellin was found to have a marked inhibitory effect on the motility of human spermatozoa in low concentrations (1 :40,000).

The feeding of Khellin to albino rats (25 mg./Kgm. body wt.) had no significant effect on the rate of reproduction, and dosages of 45 mgm./Kgm. body wt. or more decreased the fertility but had marked toxic effects. In view of the potent spermatocidal activity of Khellin on human spermatozoa, the drug deserves clinical trial.

49. Antiacetylcholine activity of four antiarrhythmic S.c. compounds on cardiac, smooth and skeletal muscles.

R. B. ARORA and H. R. K. ARORA, New Delhi.

The antiacetylcholine activity of β-diisopropyl-aminoethyl-4-phenyl-4-tetrahydropyran carboxylate hydrochloride (S.c. 3323.) β-diethyl-aminoethyl-2,6-dimethyl-5, dihydro-4-pyran-3-carboxylate hydrochloride (S.c. 3412.), n-(γ-isopropylaminopropyl)-α, α-diphenyl acetamide hydrochloride (S.c. 3920.), N,N,Ns/Triphenyl-N-(β-diethylaminoethyl) urea hydrochloride, (S.c. 2919.) has been tested on smooth cardiac and skeletal muscles. The activity does not appear to run parallel either with their antiarrhythmic activity, nor does there appear to be any definite relation between their antiacetylcholine activity as tested on different tissues. Thus S.C. 3629 and 3412 which have been shown to be effective in both auricular as well as ventricular arrhythmias (Winbury and Hemmer 1955, J.P.E.T.) possess distinctly less antiacetylcholine activity in comparison to S.C. 3323 which is not as potent as an antiarrhythmic agent. The authors agree with Van Dongen and Taal (1950, Arch. Int. Pharmacodyn.) that the two properties viz., antiarrhythmic and antiacetylcholine, are not essentially related to one another.

50. Further studies on Thiazole derivatives for Antihistaminic and Spasmolytic properties.

J. K. MOHANTY, B. N. DAS and P. TRIPATHY, Cuttack.

Seven compounds which are thiazole derivatives were screened for antihistaminic and spasmolytic activities. Antihistaminic property was tested by observing the blocking effect of histamine induced spasm of isolated guinea-pig ileum and prevention of histamine-induced hypotension in chloralosed dogs. Spasmolytic action was studied on guinea-pig ileum by using acetylcholine as the spasmogen. From the results of this study it appeared that all the compounds which have fused quinoline and thiazole rings in its molecule exhibited antihistaminic and antispasmodic activity. Compound M-81BP (Code number) seems to be the most potent of the series. Its antihistaminic potency seems to be slightly stronger than Antazoline Hydrochloride (Antistine). The compounds which have no quinoline ring were found to possess no antihistaminic and spasmolytic properties.

51. On the test for non-antigenicity of Protein hydrolysate injection according to U.S. Pharmacopoeia.

A. N. BOSE, B. K. BOSE and S. BOSE, Calcutta.

Protein hydrolysate injection has established itself as a valuable therapeutic agent in the control of malnutrition, hypoproteinaemia and other associated conditions. In order that no untoward reactions happen on infusion, several biological tests have been laid in the pharmacopoeias which include a test of non-antigenicity according to U. S. Pharmacopoeia.

When applying the U.S.P. test for non-antigenicity to some batches of Protein hydrolysate prepared by enzymic digestion, it was found that guineapigs, sensitised by the type antigen (Sensitising solution), when assaulted with protein hydrolysate (3 ml.) failed to show significant anaphylactic reactions. But when a group of guineapigs were sensitised with the protein hydrolysate, and subsequently challenged with even a small dose of the antigen solution (0·5 ml.) severe typical anaphylactic reactions were observed. Higher assaulting doses resulted in death with typical symptoms described in U.S.P. The cause of this increased sensitivity of non-antigenicity test is explained on the basis of the fact that it requires small content of antigen to sensitise an animal but a large dose is necessary for eliciting typical anaphylaxis. The assaulting dose of protein hydrolysate (3 ml.) contains possibly much lower quantity of antigen than that required for producing reactions. It is therefore suggested that the U.S.P. test for non-antigenicity of protein hydrolysate injection be modified according to the procedure laid in this paper, to increase the sensitivity of the test.

MISCELLANEOUS

52. Physiological basis of Alkali Tolerance. II—Relative absorption of water and Sodium Carbonate.

K. L. MUKHERJEE and L. V. VENKATARAMAN, Banaras.

The comparative tolerance of Eragrostis tenella, Eleusine sp., and Cyperus rotundus to withstand high alkalinity due to Na_2CO_3 in the culture medium has been worked out. The susceptible species Cyperus, are found to possess certain characteristic features different from those of the tolerant species Eleusine and Eragrostis. They are poor in their water absorbing capacity in an alkaline medium and probably possess a less powerful regulatory mechanism in roots in restricting the incoming and subsequent distribution of unhealthy elements like Na. Tolerant species like Eleusine can stand a very high concentration of Na_2CO_3 in the root environment but at the same time possess considerable water absorbing and alkali accumulating capacity with a high ratio of the amounts of absorbed water/absorbed Na_2CO_3. On the basis of the findings of the present experiment and earlier experiments it will perhaps be not too impertinent to deduce the presence of a sort of regulatory mechanism in the roots of alkali-tolerant species which governs a selective absorption and distribution of toxic elements like Na in the plant body

53. Physiological basis of Alkali Tolerance. I—Absorption of Na, K and Ca.

K. L. MUKHERJEE, K. SATYANARAYANA and C. C. RAO, Banaras.

An effort has been made to investigate the causes for the alkali tolerance of Eragrostis tenella in the Usar soils at the vicinity of Varanasi. Na, K and Ca in the component parts of the plant have been analysed by means of a flame photometer. The analyses produce an interesting result to show the influences of these cations over each other regarding their absorption and subsequent distribution within the plant. The absorbing organ shows wide fluctuations in the contents of these elements under normal and alkaline conditions, but their subsequent distribution in the plant body is judged by the behaviour of the element towards the plant growth, specially under unfavourable edaphic conditions. Toxic elements (e.g. Na) may possibly be retained by the roots and not allowed to translocate freely inside the plant body. The presence of a sort of regulatory mechanism is perhaps existing in roots which governs the distribution of unhealthy elements for plant growth. Stems act passively in regularising this translocation process e.g. higher calcium content in the stem shows an antidoting effect in the progress of sodium from the roots towards the leaves. As a result of these, the leaves are kept as far as possible in a state of physiological balance for a successful functioning of food manufacture and are least affected by changes in the edaphic conditions.

Further work is in progress with other alkali tolerant species to confirm the above findings.

54. The utilization of Starch by two species of Phyllosticta.

R. N. TANDON and K. S. BILGRAMI, Allahabad.

The utilization of starch by two pathogenic species of *Phyllosticta* viz. *P. cycadina* and *P. artocarpina* was studied in detail. Daily chromatographic analysis of the culture medium revealed that both the species of *Phyllosticta* used the starch after hydrolysis. The results also showed that besides the hydrolytic products of starch (viz. maltose and glucose), three oligosaccharides were also synthesized in the medium. Iodine test revealed that the growth of *P. cycadina* and *P. artocarpina* caused disappearance of starch of the culture mediums on 3rd and 4th day respectively.

55. Sulphur requirements of two species of Phyllosticta.

R. N. TANDON and K. S. BILGRAMI, Allahabad.

The influence of ten different sources of sulphur was studied on the growth and sporulation of *Phyllosticta cycadina* and *P. artocarpina.*

Magnesium sulphate and cystein were best sources. Good mycelial growth was also attained on potassium sulphate, sodium thiosulphate, sodium bisulphate and potassium persulphate. Sodium bisulphate was a moderate source, while ammonium sulphate and thiourea were significantly poor sources for both the organisms. These fungi failed to grow on zinc sulphate or on media which were devoid of any sulphur.

Magnesium sulphate and potassium sulphate supported excellent and good sporulation respectively of both the species. Poor sporulation was recorded on potassium persulphate, sodium thiosulphate and thiourea. There was no sporulation on ammonium sulphate. Sodium bisulphate was good and fair for the sporulation of *P. artocarpina* and *P. cycadina* respectively, while sodium bisulphate was fair for both the species.

SECTION OF PSYCHOLOGY AND EDUCATIONAL SCIENCES

President :—DR. S. S. JALOTA, M.A., D.Phil.

Abstracts

THEORETICAL

1. The Historical Development and Significance of Binocular Colour Mixture for the Theory of Colour Vision.

RHEA S. DAS, Calcutta.

In binocular colour mixture, two lights of different physical specification are presented to the organism so that the retina of one eye receives one light, and the retina of the other eye receives the other light. Observations and experiments with binocular colour mixture have yielded three types of sensations : fusion, rivalry, and dominance. In *fusion*, a single sensation intermediate in colour between the two component colours appears, in *rivalry*, there is an alternating back and forth of sensations; and in *dominance*, one monocular field suppresses the other. The significance of binocular colour mixture arises out of a main problem in the Theory of Colour Vision. According to the Young-Helmholtz theory, the brain mediates the perception of colour and only three retinal receptors are postulated; while brain mediation is not assumed by the four retinal receptor theories of Hering and of Ladd-Franklin. Binocular colour mixture experiments have been proposed as providing the crucial test of these theories. If fusion takes place, resulting in a sensation different from the monocular impressions of the two lights, then the assumption of central perception of colour is tenable. This problem has not been solved by the experimental data accumulated until now. It is proposed that suitable experiments should be carried out taking into consideration the following criteria : (i) Physical specification of the Spectro-radiometric distribution of each light; (ii) Use of pairs of lights which produce yellow by monocular colour mixture; (iii) Matching the binocular mixture with a monocular mixture in time; (iv) Utilising a statistical experimental design which will be free from ambiguous interpretation; and (v) An objective analysis of results using statistical tests of significance.

2. Mind—its bases and development.

SHIBDAS BHATTACHARJEE, Somapur.

Mind has a physical basis in the central Nervous system. It is a reaction of a part of CNS to outside impulses. Its most important sections, consciousness, volition, intelligence, wisdom, are intimately connected with each other. Impulses received are partly stored and partly expended in appropriate bodily activity. The reason for different effect of the same impulses on different individuals is to be sought in the presence of contradictions, and an unequal development of these contradictions due to hereditary and acquired factors.

Contradiction is the rule of nature. Its cause is traced to the origin of creation. Darwin proved a possibility of the origin of man from anthropoid apes. By similar observations and deductions, it can be concluded that anthropoids originated from unicellular animals, unicellular animals from unicellular vegetables and unicellular vegetables from nonliving matters. All nonliving matter originates from 93 elements, and the atoms of all elements are derived from Protons, neutrons and electrons. Electrons are particles of almost massless negative electricity, pointing towards fourth stage of matter viz. massless forms of congealed energy. Origin of creation is therefore from a neutral form of energy whose neutrality is due to presence of exactly similar but opposite energies, like North and South Polarity of Magnetism, the positive and negative charges of Electricity.

EXPERIMENTAL STUDIES

3. Verification of Bartlett's experiments on remembering.

SUBIMAL DEB, Calcutta.

The study is made to verify Bartlett's revolutionary experiments on remembering. Remembering is manifested when a present set of stimuli reinstates a past occurrence. It suggests the very common basis of imagery. Although the memory image has certain features in common with the sensory after-image but it is different in some respect. Bartlett F. C. (1932) has undertaken the whole remembering procedure with a more categorical explanation. He establishes that in remembering we tend to recall organised patterns or configurations. From within the matter to be remembered we select certain key experiences and organise them into a meaningful "schema". While remembering is a tendency to remember only a general plan or order or arrangement and fill in this schema with logical interpretation.

The present experiment includes Expt I—to show the tendency to transform in the direction of accepted conventional representations and Expt. II—to study the nature of elaboration. It is concluded thus—(1) whenever material visually represented purports to be reppresentative of some common object, but contains certain features which are unfamiliar in the community to which the material is introduced, these features invariably suffer transformation in the direction of the familiar (Expt. I); and (2) picture-material involving higher set of perceiving, show multiplication of features ultimately favouring invention (Expt. II).

4. A Psychological Scale of Weight.

R. G. CHATTERJEA and RAMANATH KUNDU, Calcutta.

The papers deals with the report of an experiment on subjective weight, in which comparison weights were presented in two different ways. In the one comparison weights were presented in serial order, while in the other the comparison weights were all mixed up. The method of fractionation was used. Standard weights of 40, 60, 120, 160 and 200 grams were tried. There were four comparison weights corresponding to each standard. Twenty-five subjects participated in the experiment. The medium weight of the two presentations showed no appreciable variation. A weight of 63 grams was judged half as heavy as a weight of 100 grams. Thus the weight 63 grams was regarded as half *Veg* and a scale of subjective weight was constructed.

5. The differences in Reaction time as affected by Direct and Indirect vision.

ARUN K. SARKAR, Calcutta.

The problem is whether R.T. varies with the presentation of the stimulus directly and indirectly to the subject. In this case, light stimulus has been used and the present experimenter's purpose is to see whether R.T. of an individual is affected by direct and indirect vision.

The arrangements were made to present the light stimulus directly and indirectly from four positions, left, right, upward and downward. According to instructions, subjects' responses are of muscular in nature and a general report is obtained from each of the subjects after each series of experiment.

Analysis of variance is done between five sets of data, and F is highly significant. This is followed by the procedure to see the difference between means. Out of four means, obtained from indirect positions, three differ from direct mean significantly.

The obtained results lead to conclusion that R.T. from direct presentation differ significantly from the indirect presentation. The results corroborate other workers' results in some points.

6. An experimental study of Reversible Perspective and Neuroticism.

A. K. P. SINHA and S. N. SINHA, Patna.

The purpose of this experiment was to test the following hypothesis: Subjects with high neuroticism scores will have a relatively low rate of perspective reversal as compared with those having low neuroticism scores, who will have a relatively high rate of reversal. Two groups of subjects: Group—I High neuroticism group and Group—II Low neuroticism group, selected on the basis of Maudsley Personality Inventory, were administered Necker Cube test of Perspective Reversal. The mean perspective reversal for high neuroticism group was 17 2 and for the low neuroticism was 31·5. When 't' ratio was computed it was found, to be 3·3 which is significant beyond ·01, level of confidence. The results confirm our hypothesis and are in keeping with Eysneck's findings. Rigidity in reaction patterns has been regarded as symptematic of neuroticism. The above findings also give ample demonstration of the same.

7. Direction finding mechanism in the Leech.

NIROD MUKERJI, Gauhati.

1. Classification of the animal used—Description of the sensory apparatus (sensillæ) and the optical mechanism.

2. Description of the casual observation, and later, of the more controlled observations leading to the subject matter of the present investigation viz., in the absence of image forming optical organs how does the leech locate its host?

3. Present field of inquiry: (i) In the light of von Frisch's findings in the bees using polarized light for locomotion (and in many insects found since), would it be justifiable to expect a similar mechanism operating in the leech? (ii) Do the sensillæ on the body surface aid in phototropism?

4. Results of the preliminary observations.

8. Correction for Guessing in Item-Analysis.

TAPAS K. SEN, Calcutta.

The present paper deals with an empirical comparison of three methods of finding item-analysis values, as applied to a set of data obtained on two similar groups of candidates seeking admission to two medical colleges in India. A number of four-choice general knowledge test items were administered to the groups. Difficulty and discrimination values were obtained by the top and bottom 27% method. Three types of proportions were used, e.g., uncorrected proportions, proportions corrected by Guilford's formula and proportions corrected by Horst's formula. Correlation was obtained between similar item analysis values for the two groups to examine the consistency of the values as given by each of the methods.

9. Development of a Differential Aptitude Test Battery : A Pilot Study.

S. CHATTERJI and TAPAS K. SEN, Calcutta.

The present paper is a research report on the development of a battery of differential aptitude tests for science and arts at the college-entrance level. Six tests were administered to two groups of college freshmen in a Calcutta suburban college. One of the groups was a science group while the other was an arts group. The present report gives the preliminary findings of the pilot study and relevant analyses of the results.

10. A method for developing Stick-figure items for non-verbal tests.

S. CHATTERJI, Calcutta.

This paper presents and discusses a special inexpensive procedure for constructing stick-figure items for non-verbal tests. This procedure does away with the necessity of taking the help of any professional artists, which is of special importance. It is not known whether the procedure we have discussed here is the best possible one, but it was one which we found to be both useful and practical.

11. Relation between Manifest and Inventoried Interest of College Freshmen.

S. CHATTERJI, Calcutta.

This paper deals with the relationship between the various approaches to the measurement of interests and discusses in detail the finding of an investigation into the relationship between Manifest and Inventoried interests as it exists under our cultural and economic set up. Twofold analysis of the data involving a general comparison of the obtained results from the two methods of assessment, and comparison of each of the preference and experience profile for every individual candidate was done.

12. Series Completion Test : A test of reasoning.

SHIB K. MITRA, Calcutta

The Analogies item is a basic item-type in reasoning tests, verbal as well as non-verbal. The latter have some special difficulties. A new approach to non-verbal reasoning items is considered. Details of an attempt to develop equivalent forms are presented. Conversion table for the two forms of Series Completion Test is given.

13. Standardisation of Progressive Matrices among the college students.

R. RATH, Cuttack.

When there is a great demand for intelligence tests the author thought it wise to standardise some well known non-verbal tests of Intelligence on an Indian population. Raven's progressive matrices were selected for the purpose as they were supposed to be culture-free also.

The matrices were applied on 426 graduates and 325 undergraduates. The scores of these two samples compared very well with those of Raven's tests, which were based on 5,857 people. The retest reliability of the tests was found to be very highly significant. The scores were further correlated with the marks obtained in Arithmetic, English, General Knowledge and another form of a Verbal Intelligence test. The Matrices correlated significantly at more than one per cent level with the Verbal Intelligence tests and Arithmetic and at five per cent level with General knowledge but did not correlate significantly with English ; whereas the scores of Verbal Intelligence Tests correlated at 5 per cent level with the marks in English and General Knowledge and at one per cent level with Arithmetic. But the correlation between the scores of the two Intelligence tests was found to be the highest.

14. A proposed method of Combining the Thurstone method and the Likert method in the attitude scale construction.

B. DAS GUPTA and B. GANGULY, Calcutta.

A proposal to combine the methods due to Thurstone and to Likert in the attitude scale construction was made by Eysenck and Crown (1949) in the form of scale-products. The item scale values obtained by Thurstone method is multiplied by the scale values for the response alternatives as obtained by the Likert's method. The method suffers from the absence of a theoretical basis of taking such products. In this paper an alternative method of combination is suggested and a theoretical basis is provided for the same. An experimental study to evaluate the four methods is also described.

15. A Note on Weighting Response Categories.

S. DAS GUPTA, Calcutta.

In item analysis of attitude tests, often an investigator is confronted with the problem of scaling the different responses to an item. Firstly, the different responses are arranged in a definite order (by analysing the contents of the response categories) over the linear continum (assumption) of the attitude scale. Keeping the order of the response categories, conditions have been derived in this paper under which the scale values of the response categories, can be determined by maximising the validity of the item with respect to a known criterion. For a given manifest of data Wherry's scale values may not conform to the given system of ordering of the response categories.

To obviate this difficulty a method is also suggested in this paper by which the scale values of the response categories can be obtained by maximising the validity of the item, and maintaining the order of the response categories as far as possible, i.e., by coalescing some of the consecutive response categories and attaching a common scale value to them. A method by 'iteration' is suggested for the solution.

PERSONALITY AND PERSONALITY TESTING

16. The need for an independent, self-reliant approach to the study of personality in Indian Universities.

INDRA SEN, Pondicherry.

The ideal of *Atmānam viddhi* (Know Thyself), the principles of *Adhikarbheda* (the distinctive status and right of eligibility of a person for social position, education and spiritual sādhana), of *Swabhāv* and *Swadharma* (own being and own action), the general introspective habit of life, the emphasis on attitudes and values rather than on forms and creeds in general Indian life and the vast body of knowledge of personality present in the yogic systems, philosophies, religions, all tends to bear out that Psychology must have been a strong interest in Indian life and culture. And yet we do not seem to be conscious of it, and this is particularly so in the academic circles. May this not be due to our having, more or less, exclusively identified ourselves with an approach to personality which shuts out the Indian approach?

Let us attempt a comparison of the approaches of modern scientific psychology and that of Indian psychology. Let us also seek to know the sum of our knowledge of personality in contemporary psychology from two of its best representatives, Jung and Murphy. Its inadequacy has exactly been the field of special interest to Indian psychology. The two bodies of psychological knowledge are thus happily complementary. The need for a fresh approach to the study of personality, making use of all experiences of personality, modern as well as ancient. Western as well as Eastern, to evolve a true and comprehensive knowledge of personality is therefore a great need today as a whole. But it is particularly relevant that India, because of her acquaintance with both the lines of thought, takes an independent and a self-reliant approach and attempts to achieve a true, full and satisfying knowledge of personality.

17. Tests for Measuring Anxiety.

DURGANAND SINHA, Kharagpur.

Of late anxiety has become a nodal concept in psychology. A brief review of various tests—psychometric physiological and behavioural—is given. It is suggested that lack of closer interrelationship between various indicants points to the necessity of resolving the question whether anxiety is a single dimension or not.

The new tests of anxiety developed by the author are described. One has reference to childhood anxieties, and the other to different physiological and psychological symptoms as well as various areas of behaviour where anxiety usually manifests itself. As a part of the preliminary investigation, these two along with the Taylor Scale were given to a small sample of university students. Their distributions are discussed. The intercorrelations between 'childhood Anxiety Test' and 'Anxiety Test' was 61 (p=·01) 'Childhood' and 'Taylor Scale' ·52 (p=·02), and Anxiety Test and Taylor Scale ·76 (p=·01). The correlations suggest some communality of traits measured by the three tests. The size of correlations with such a widely used test like the Taylor Scale are encouraging. Further investigation is in progress.

18. A note on the American and Indian weight scores on Allport's A-S Reaction Study.

K. RAY CHOWDHURY, Aligarh.

In 1957 (October-December) P. S. Hundal and J. S. Gandhi worked under the supervision of the present writer on the preparation of weight scores of the items of Allport's A.-S Reaction Study in Indian Situation (cf. *Indian Psychological Bulletin*. Vol. III, Part I).

In this paper the present writer reports a further enquiry into the agreement between weight scores obtained by Allport and others in U.S.A., and those obtained in India. The present investigator assigned weight scores to Hundal's 90 cases, collected under three samples of 30 Graduates (Men) each, and Gandhi's 30 cases (out of 90 Women graduate teachers) according to American weight scores and also according to the Indian weight scores. The range of the product-moment correlation co-efficients obtained from these samples was from ·88 to ·918. These high correlations mainly suggest two things : *firstly*, the method applied to obtain the weight scores in Indian situation seems to be satisfactory; *secondly*, it suggests that the test might have accidentally sampled fairly representative ascendance-submission behaviours of Indian Graduates as well; and, therefore, we could even accept the American weight scores. Our second assumption is further supported by the high split-half reliability co-efficients obtained by Hundal and Gandhi.

19. Study on the differences in Rorschach's responses between educated and uneducated groups.

APARNA GUHA, Delhi.

Rorschach's plates were applied on two groups of 20 persons each : *Reaction time* :—Educated group 300 and uneducated 124 seconds in average. Total time taken in average educated 997 against 612 seconds by uneducated. Time recording indicates subjects emotional blocking or resistance. (*Finding* : Educated persons are more resistive, due to emotional blocking). *"Whole" responses* : Educated 63% against 54% by uneducated in average; indicating power of configuration and high intelligence of educated group. *"Form" responses* are indicative of intelligence and control over intellectual processes. Educated gave 76% responses against 57% by uneducated. (Educated group possesses more of these qualities.) *"Colour" responses* : Indicative of impulsiveness and emotionality—both groups gave 37% responses. (No difference).

'K' response or seeing shades : Indicative of introversion, anxiety and insecurity. Both groups gave the same 40% response. (No difference).

'M' responses : Indicating richness of imagination. Educated gave 44% response against 40% by uneducated. (Educated slightly richer in imagination).

"Popular and original" responses : Indicating socio-cultural background. Both groups gave equal responses—particularly in plates Nos. V, VIII and I.

(*Finding* : Education has not been able to remould socio-culltural inheritance.)

Conclusion : Study on a larger data may give a more accurate result; but result obtained on these data may be taken as fairly correct.

20. Interest patterns in Adoloscent Girls and their Relation to personality patterns.

SATNAM KAUR and SATINDER BAWA, New Delhi.

This paper is an attempt to study the Interest Pattern of adoloscent girls and their relation to personality patterns For its investigation Thurstone Interest Inventory and Bernreuter Personality Schedule modified by Indian Statistical Institute have been applied on forty girls coming from various socio-economic back grounds.

The results of this investigation are given below :

A. (i) The most popular interest pattern found among girls is of the descriptive type. (ii) Next is the academic pattern of interest. (iii) The third is the physical science interest pattern. (iv) Physical activity and biological interest patterns come next. (v) Lastly, legal and commercial interests are rarely found among girls.

B. (i) The girls whose interest pattern is of the *descriptive* type are dominating, not-neurotic and extrovert in personality pattern. (ii) The girls whose interest pattern is of the *academic* type are neurotic, dominating and introvert in personality pattern. (iii) The girls who show interest in the *physical sciences* are neurotic, submissive, introvert and not-self-sufficient in personality pattern. (iv) The girls whose interest pattern is of the *biological* type are not-neurotic, introvert, dominating and not-self-sufficient in personality pattern. (v) The girls who show interest in *physical activity* are dominating, introvert, not-neurotic and not-self-sufficient in the personality pattern.

The investigation has been done on a small number of individuals. It suggests that something definitely can be predicted on further investigation.

21. Development of a new Introversion-Extraversion Inventory (First Report).

TAPAS KUMAR SEN, Calcutta.

The preliminary stages of development cf an introversion-extraversion inventory, which would suit Indian situations and would reduce faking to minimum, have been reported in this paper.

An introversion-extraversion inventory consisting of 5 blocks of 15 items each was constructed by the authors. Measures were adopted, while constructing this inventory, to make the items socially non-aggressive and slightly projective in nature. Fifteen aggressive type items that are found in usual extraversion-introversion tests were, however, included in block-5 to get comparative results. The inventory was administered to two groups : Group A in selection situation, and Group B in a non-selection situation. The size of each group was 87.

It was observed that in general Group B consisted of more extravert persons than in Group A; but in block 5, containing aggressive type items, the selection group tried to take consistently, so that on this block their extraversion score showed higher mean and lower spread than the corresponding results in Group B. The inter-correlation coefficients between different blocks were found to be quite low, supporting one of the authors' hypotheses that introversion-extraversion has different dimensions.

22. A study on the Relation between W-responses on Rorschach test and I.Q.

VIMAL GROVER and SHUKLA KHANNA, Delhi.

Rorschach has claimed that 'W, F+, and M' responses indicate the intellectual level of the subject. The object of this paper is to verify this statement. To do this Terman-Merrill Group-Intelligence test and Rorschach's Psycho-diagnostic tests have been applied upon a group of twenty students. The results obtained on the response-putterns of 'W, F+, and M' have been correlated with the I.Q. The correlation in case of 'W' response is ·53; in F+ ·48 in M ·38. This shows that there does exist some relation between the response pattern (W, F+, M), and subject's level of intelligence, imaginativeness and creativeness.

As the number of data is not very large, a further investigation of the problem will be continued.

23. A new type of sentence completion test technique.

RAM MURTI LOOMBA, Lucknow

The paper presents a preliminary report about a new sentence completion test technique devised by the author. This technique is characterized by

1. unstructuredness of the sentence beginnings, which gets over the limitations of selective sampling of personality of the examiner's biasses in personality analysis, and of narrowness of applicability of the technique; and which makes it a culture-free technique;
2. use of first personal pronouns as the sentence begins, which serve as good anxiety instigators, are capable of drawing out conflicts, and enable the technique to be used with all persons of six or more years in age; and
3. presentation of the same beginings over and over again in a random order, which enables a more complete clinical assessment of the individual, secures reliability of the findings from the responses evoked, and ensures the projection of progressively more affective and 'deeper' aspects of the personality.

The use of the new test technique in the investigation of the self-concept of a clinic client is described, and the broad directions of analysis of responses to the test for such a purpose are indicated.

24. Effect of Psychological Factors on Educational Achievement.

ONKARNATH GANGULY, Calcutta.

The purpose of this study is to find out the effect of Intelligence, environment and personality factors on examination success.

An Intelligence test was applied on 206 students of Class VI to X of a Higher Secondary Hindi School, Calcutta. A correlation of Intelligence test score with Examination marks was found to be ·56. By regression equation the deviation between obtained and predicted Examination marks was worked out and according to the variation of residual score three groups were divided as follows:—(1) Who scored better in Examination than they should according to their Intelligence. (2) Who scored almost equal. (3) Who scored less than they should according to Intelligence. A questionairre consisting of 30 items to assess the environment and Rorschach Projective test was applied to 15 randomly selected students from each group.

The result shows that the students of first group i.e. those who are stereotype-constricted shutup type, with narrow interest and better environment, can do better in examination than they should according to intelligence. But the students whose environment is unfavourable, and who are emotional-impulsive, and who possess a wider range of interest usually scored *low* in our present examination system than they should according to their I.Q. or power of organisation, integration (R) and abstract thinking.

25. The beginnings of a small, part-time college examination office.

A. EDWIN HARPER, Jr. and SUSHIL K. V. LIDDLE, Allahabad.

Ewing Christian College has been using objective examinations in various ways for several years. One department has been using them continuously for over nine years. A small office, consisting of two psychologists and one clerk-typist, was established a year ago. Only a part of the work and duties of this office pertain to objective examinations in the college. Yet in only its first eight months it assisted in various ways with 18 different tests and examinations in 6 different Arts and Science subjects (each a different college department), involving a total number of nearly two thousand tests. All of these objective tests and examinations were *written by the teachers concerned,* not by the psychologists. Services of the examinations office include : (1) Assistance in defining educational objectives, test planning and item writing techniques; (2) editorial revision of items; (3) test production (design of answer sheet and test lay-out and format, reproducton, etc.); (4) "information sheets" and other aids to administration; (5) test scoring; (6) aid in scaling (though it is always the *teacher who sets the marks*); (7) item analysis, separately by class sections and also for the group as a whole; (8) complete test analysis. Special methods have been developed to accomplish this with a minimum of time and labour.

26. The validity of some objective examinations prepared by teachers for use in a college.

A. EDWIN HARPER, Jr and SUSHIL K. V. LIDDLE, Allahabad.

This paper reports various types of data on several objective examinations which have been prepared by teachers at Ewing Christian College, for use as class tests and Terminal and Annual Examinations The data do not uniformly favour either the traditional essay-type or the newer objective-type examinations, although they reveal many interesting comparisons between the two.

27. Parent-Teacher Expectation Inventory.

P. M. PATEL, Baroda.

This is an initial report of a fact-finding study on 'Development of an Effective School Programme.' The present paper explores, the areas of expectations and duties of parents and teachers in the development of Children. It thus seeks to answer the five questions : (1) What do the parents expect from the teacher and the school? (2) What do the parents consider to be their own responsibilities? (3) What do the teachers expect from the parents? (4) What do the teachers consider to be their own responsibilities? and (5) What do the parents and teachers consider to be their joint responsibilities?

"Parent—Teacher Expectation Inventory" was evolved in order to answer these questions. The inventory consisted of three sections : Section A for parents; Section B for teachers; and Section C was common for both parents and teachers. The sample consists of 88 parents, teachers and parent-teachers. The analysis of the data resulted in the following conclusions :

(1) The duties of parents and teachers expected by parents are somehow common to all. However, it shows that there is no general agreement among parents about the fundamental tasks of parents and teachers. Thus therefore arises the need for parental guidance to make them aware of their basic responsibilities to the right perspective of education.

(2) Among the teachers also there is little consistency in enumeration of their duties. Again the fact that what do the teachers expect from themselves is not clear in their minds. It should be concluded that a thorough and persistent effort is necessary to give them expert training in this field.

(3) Majority of the parents and teachers, nearly 75%, has agreed that both parents and teachers were responsible for the over-all development of the children. Both expressed their willingness for one another's cooperation. Hence a well-developed school programme necessitates the participation of both the parents and teachers.

28. An analysis of Motives for the Choice of Teaching Profession.

R. G. CHATTERJEA and RAMANATH KUNDU, Calcutta.

The present investigation is a part-study of the authors' long-term project to analyse the motives for the choice of teaching profession. This paper deals with the responses of college teachers.

A well-planned questionnaire with twenty-one items was prepared for the purpose. There was also a provision to add any other motive or motives which the teachers, responding to the questionnaire, might think should have been included in the list.

The questionnaire was given to the teachers of different Calcutta colleges and they were requested to mark either 'yes' or 'no', as the case may be, to each item in the questionnaire. For preliminary investigation 85 such responses were considered.

The data were analysed and the twenty-one motives were arranged in rank order. The rank order was determined according to the frequency of 'yes' responses. The motives having 1st rank order are—"the desire to continue further studies" and "this line affords much study to continue undisturbed studies." The motives were classified as desirable, selfish and incidental. It was found that desirable motives play most important part in attracting people to teaching profession.

Further studies with this questionnaire are in progress and will be reported later.

29. New Evaluation Technique.

K. K. PAKANIKAR, Poona.

Background : evaluation officers appointed by Central Education Ministry; objective : working out scheme for reforming examination system; training by Dr. Bloom, working in different zones, conducting short evaluation courses for secondary teachers, team of University teachers studying American examination system; analysis of technique opportune, objective—improvement of examination system and education standard.

New evaluation technique : (1) determining objectives—reference; particular subject—the class to which subject is taught, explanation; (2) assignment of behaviour patterns against objectives, explanation; (3) analysis of syllabus against objectives and behaviour patterns; Test Construction technique. *Prospect*—improvement upon examination system will improve teaching and measurement of progress. *Danger*—exhaustive types of test items will be available; result—coaching for bettering prospects will defeat evaluation purpose; Coaching is temtping; undue weight to final examination; final examination impersonal, no proper judgement; Those who teach have no proper place in system; examiners do not specifically know what they measure.

Proposed scheme—those who teach must have foremost place in system; new assessment method—they give passport to appear for final examination; final examination to determine pass—failure; classes given by those who teach.

Experimentation by schools, Universities, not by individual teachers; trust in the teacher essential—way out may be found.

30. An experimental study of humor in children.

S. SUNDARAM, New Delhi.

This investigation concerns the relation of a child's mental development to his sense of humor between the ages of five and ten. Corresponding to the stages in the emotional intellectual, and social development of the child, five types of humor were chosen. These were to be related to age and intelligence. The types chosen were "Deflation of Adult Authority", "Discomfort of Others", "Incongruity", "Fantastic" and "Human Oddities". Thirty pictures were chosen, six of each type. These pictures were shown to 72 children, boys and girls of I.Q.s above 120 and below 120. The pictures were marked for funniness. Analysis of variance was done on the scores obtained.

Results : The most popular types of humor were Incongruity, Authority Deflation and Oddity of Human Behavior. Discomfort of others as a type was more popular with children of lower intelligence. Fantastic pictures were liked more by the younger children.

Except for one type, there was no distinct sex-difference in the liking for pictures. The type of pictures which are popular vary significantly with age. The results justify to a certain extent the conclusion that a child's sense of humor is closely related to his mental development.

31. An Experimental Study of Card Punching Aptitude.

RHEA S. DAS, Calcutta.

An increasing number of business houses and governmental departments are adopting punched card equipment in India, for purposes of accounting, analyzing statistical data, processing sales figures, and other large scale numerical operations. As a result, there is a growing demand for card punch operators, in excess of the existing supply, and greater than the capacity of existing training facilities. This raises the practical problem of selecting persons who are potentially efficient card punch operators. To solve this problem, the personnel psychologist must first determine the aptitudes required for efficient card punching, and second develop tests for personnel selection in Indian conditions. An experimental study was directed toward this problem, consisting of the following steps : (i) detailed job analysis, as the basis for all subsequent steps; (ii) development of aptitude tests in terms of the job analysis; (iii) administration of the tests to groups of card punch operators; and (iv) validation of the test results. Eight aptitude tests were administered to a group of employed card punch operators, for whom two measures of proficiency were available : (i) a cost accounting efficiency index and (ii) supervisors' ratings on twelve variables. The final supervisors' rating, *a summary rating* of general efficiency, was used as the validation criterion. Statistical analysis of the results showed that at least two aptitudes are required for efficient card punching : motor speed, or the quickness with which simple hand movements can be made, and perceptual speed and accuracy. Suitable tests for the assessment of these two aptitudes have been developed for the selection of experienced operators and unexperienced applicants *for* training.

32. Proficiency in academic subjects required for engineering profession.

MAYA DEB (neé GUHA) Allahabad

In order to minimise national wastage, selection of personnel for vocational training is becoming more and more important The cost and length of training are high in some profession. So to select men by the method of trial and error for such vocational training means a wastage of time, money and energy. For this purpose the selecting authorities ought to have a clear picture about the requirements of a job It may refer to the mental abilities, temperamental qualities, physical abilities, aptitudes and also proficiency in different subjects, or other associated factors, which are deemed necessary for success in a particular vocation.

Here an attempt has been made to determine the relative importance of attainment in academic subjects as an indicator of success in engineering profession. Some 300 engineers, from all over India, were approached and this study is based on the data obtained from them. The findings show that three academic subjects are intimately associated with success in engineering profession. Those three subjects are Physics, Drawing and Mathematics (both pure and applied branches like arithmetic, algebra, geometry, trigonometry, statics and dynamics).

33. A Psychological Study of the Artists.

PRYANSHU SEKHAR BHATTACHARJEE, Calcutta.

The aim of the survey was to study the psychological make-up of the artists. The subjects in this small study were artists of all-India fame, came from different parts of our country. Twenty such subjects took part in this project of study. They were interviewed separately and two questionnaires namely Introvert-Extrovert test, and Neurotic questionnaire (Calcutta University) were administered along with an information schedule which was filled up by each of them.

The case histories reveal that most of the subjects were men of integrity. An impulsive trend was found to work in most of the personalities of the subjects. Study of the cases and the objective questionnaire results show the subjects prone to artistic skills from their very childhood in overt or covert approach, were *introvert*. The artists who developed the above skill in later stage by influence of the circumstances were found *extrovert*. So far as this study is concerned religion did not seem to influence their work. Remarkable influence due to sex difference did *not* appear.

34. A Study of Job preferences.

SANTOSH A. JUNEJA and S. SINHA, Baroda.

The paper describes an investigation to study job preferences of both boys and girls from X standard and F.Y.B.A. Classes. The following Hypotheses were formulated and then tested :

(1) Persons from different grades differ in their job preferences. (2) Boys differ from girls in their job preferences. (3) Educational level of the father has no influence on job preferences. (4) Urban and Rural groups differ in their occupational preferences. (5) Occupation of father has an influence on job preference.

A questionnaire was formulated in which information regarding the above hypotheses was got. The sample consisted of a total of 100 students : 25 girls & 25 boys each from X standard and F.Y.B.A. Classes. The collected data on being analysed gave the following results :—

(1) Students belonging to different grades differ in their job preferences and both tend to choose the occupations belonging to the same socio-economic level. (2) Boys differ from girls in their job preferences. (3) Educational level of father has *no* influence on job preferences of children. (0) Students coming from rural and urban backgrounds *do not* differ in their job preferences. (5) Occupation level (socio-economic) of father has an influence on job preferences.

35. A Survey of Opinion Regarding Marriage.

K. R. RAJAGOPALAN, Tambaram.

The paper details the results of a survey of opinion regarding a few aspects of marriage among the students of degree classes in Madras College. A stratified random sample of 191 boys (who were more than 18 years of age) was selected and responses to nine questions were recorded and analysed. The questions relate to matters like 'State Legislation' age at marriage for Boys and Girls, marriages in the same or different castes and religions, partner's economic status and educational level.

36. An Experiment on Group Dynamics.

D. BAGH, Visva-Bharati, Sriniketan.

The paper consists of a brief report of an experiment done by its author in a small Santhal (plain tribe) village in West Bengal. The experiment was first started in the month of July, 1955. The author has drawn some tentative conclusions on the basis of results obtained from the study of a series of group-situations in six different stages, ending in May 1958. The whole paper is illustrated in a diagram which provides an excellent visual aid to understand reactions (responses) due to various stimuli (social stimuli). The most interesting point of this study, as is implied, strikes to the very foundation of the idea of putting Community Organisation as the primary means for Social Education. This study has thrown new light on the life of this peace-loving, timid, taboo-bound sons of the soil. It has found out some group characteristics of the Santhals which may be considered very important and useful for those who are engaged in their welfare. Some of the important conclusions are :

1. The exciting causes for disintegration may come from (a) Outside the village, (b) Inside the village.

2. To maintain the integration of the group it is necessary to keep a *continuous* contact with the people of both the groups. 3. Once two conflicting groups are integrated it does not assure that the integration will be a permanent one. Rather it should be taken as purely temporary. 4. Complacency and lethargy seem to be almost natural with santhals. To put them to constructive work that are not conventional, a superior force must work rather *continuously*. 5. Organisational of cultural activities may be taken as the first step in Group Organisation for constructive work programme to follow. 6. Disintegration of the integrated group emanates energy, which may be utilised in the development work for both the groups. The process of integration and disintegration of conflicting groups is *exo-ergic* and is quite economical in its nature. 7. The most important point in this connection is to utilise this emanated energy in time for useful purposes. Temporal aspect is important. (This explains why constant vigilance is needed while working with the two conflicting groups of santhals). 8. Hundred per cent contribution by the villagers to establish a Social Institution in the village is possible (at least with Santhals). And this is independent of economic condition of the village. 9. The

time taken to establish such an institution is directly proportional to the amount of external and internal stimuli beyond control of workers.

37. A Comparision of Attitude Scores on some Socio-cultural and Educational Issues between two samples of College Students after an interval of four years.

R. RATH, Cuttack.

An attempt was made to assess the attitudes of college-students on a five-point scale towards six Socio-Cultural, three educational issues and three State nationalities belonging to three neighbouring states, namely the Bengalis, the Biharis and the Telugus. 450 students were tested in 1956. The distribution of test scores over a five-point scale was first examined by Chi. Sq. test to eliminate the possibility of equal distribution of scores following the theory of chance occurence probability. Then the scores of this sample were compared with those of 1952 sample which was also tested exactly in the similar manner.

Out of the total sample of 450 about 70 students were retested after two weeks to asses the retest reliability of the test.

The following conclusions might be drawn from the investigation :—

(1) The frequency of scores on a five-point scale was such that the distribution was not considered to be randomly distributed over all points of the test and consequently it could be said to express the real attitude trends of the sample.

(2) The correlations between the test and retest scores were possitively significant in all cases except for Basic education. In regard to the latter the correlation was negatively significant.

(3) A detailed comparison and analysis was made between the distributions of two sets of scores.

38. The Factor of Consistency in the Pattern of Participation in Small Groups.

AMITAVA CHATTERJEE, Bangalore.

The individual characteristic behaviours of the members of a small functional group engaged in a problem-solving task become overtly manifest, and these can be assessed both qualitatively and quantitatively. Any particular member's contribution to the group discussion conforms to a standard peculiar to him, and his total amount of contributions on each occasion over several meetings show a marked consistency. Also, the pattern of interaction for any particular member remains more or less consistent.

The present paper reports observations on behaviours of two small groups of nine and ten members respectively. The groups met for several successive days to discuss certain given case-problems during a short-term residential study course at the Indian Institute of Science. Each group was observed in five different meetings on alternate days. The interactions among group members were recorded under nine categories. The results indicated that every member's nature of participation as categorised under nine different heads, as well as every member's total amount of contributions in the series of discussions were fairly consistent.

Further analysis of the present data now under progress may show that 'situational factors' tend to affect the leadership behaviour.

39. Attitude of secondary school girls towards various language groups.

PRABHA PURI, Delhi.

In order to investigate into the attitude of XI grade girl students of Delhi city, a questionnaire was tried out on a group of 50 students; and on the basis of the results, forty items were finally selected. This revised questionnaire was administered to a sample of 129 girls from three different schools with different language composition and different socio-economic status. The subjects were selected on the basis of random sampling, and the study was not limited to any particular area. The questionnaire was based on a three point scale, i.e., the students had to say either, "yes", "no" or "uncertain" for each statement. The students were instructed not to write their names on the questionnaire form so as to get their frank opinions. Then each statement was compared with its standard obtained from the discussion among three post-graduate students, and it was seen that out of 40 statements, 28 were in agreement with their standards.

Further, each item when analysed indicated that 34 statements out of 40, showed favourable attitude toward various language groups. From this we can easily infer that the students had a favourable attitude towards other language groups.

Lastly, statistical method of analysis of variance was applied in order to find out the difference in responses of three schools in which the questionnaire was given and it was seen that the three schools differed from each other in their responses at 5 p.c. level of significance.

INDUSTRIAL PSYCHOLOGY

40. A Methodological Study of Job Analysis.

P. N. KALRA and K. N. SHARMA, Calcutta.

Job Analysis is the basic tool of Industrial Psychology and Scientific Factory and Business Management. It is used for a number of purposes like selection, training, job classification, job evaluation, etc. It can be approached by three different methods, namely Analysis Method, Description Method, and a Combined Analysis and Description Method. The third method is most widely used, although it involves more time and money.

The purpose of the present study was three-fold : firstly to estimate the reliability of the Job Analysis Method, which included Repeat Reliability, Inter-Analyst Reliability, difference in reliability for different characteristics and improvement in reliability with practice; secondly to determine if the time and money spent on Combined Analysis and Description Method is justified, and thirdly to formulate a method for assigning, and studying, the relative weight of physical, mental and personality requirements for different classes of jobs.

Analysis data was obtained for 7 jobs, grouped into three classes, mechanical, clerical and computational using IBM and Hollerith machines.

Results indicate a high Repeat and Inter-Analyst reliability. Ratings on physical characteristics and personality characteristics are seen to be more reliable than those on the mental ones. An increase in reliability has been observed with practice in Job Analysis.

It is seen that Analysis and Description contribute almost equally to the Combined Analysis and Description Method, so that the time and money spent in carrying out the Combined Method are justified.

A method has been formulated for determining the relative weightage of physical, mental and personality characteristics for various classes of jobs and some interesting facts have been reported about mechanical jobs.

41. "A comparative analysis of the opinions of Management Personnel in Public and Private Sector Industries on Selected Topical Issues".

J. C. PRAKASH, Bangalore.

The results reported in this paper are based upon the responses indicated by personnel in top-management positions in Industrial organisations on a specially constructed, multiple-choice type questionnaire. The questionnaire included items relating to the following topics: 1. Professional problems of Management. 2. Management Training. 3. Concept of Management. 4. Modern Management Techniques. 5. Management Consultants. 6. Management Decisions. 7. Workers' Participation in Management. 8. Perception of Labours' Attitude. 9. Relation of Politics with Labour and Industry. 10. Automation. 11. Governmental Policies and National Objectives. 12. Specific issues relating to Employment and Service of Management Personnel. 13. Management Functions.

This paper presents a comparative analysis of the opinions of Management personnel in public and private sector industries as indicated by their responses to the Questionnaire items relating to the topics mentioned. There is some evidence indicating that this approach as a diagnostic tool, seems to have interesting potentialities and hence it is recommended for further exploration.

42. A Study of the Worker-supervisor Relation (at Naskarpara Jute Mills).

SAMIR K. DEY, Calcutta.

In the field of Industry, the technological progress has altered various traditional concepts. Maximum efficiency is no more dependent on machines alone but also on the morale of the workers. The present study is an attempt to show experimentally what are the basic conditions by which the morale of the general workers becomes lowered and the motivational forces wane out day by day.

A survey was conducted over different types of workers representing each section of a particular factory by the method of "Verbal Question-Answer Technique" of interview. On analysis the answers for principal morale determinants have been obtained with their subsidiary ordinates. These are:

1. Satisfaction in specific job situations. 2. Company involvement. 3. Satisfaction with financial incentives. 4. Supervisors influences.

It is found that young and middle aged workers as well as those who are literate are unfavourably oriented in their attitude towards the supervisory staff and therefore there is a downward trend of their morale, whereas those on higher wage groups and those with long years of service are favourably disposed. For efficient running of an organisation there should be a relationship of mutual respect between the supervisors and the workers, and conventions of discipline and decorum. For this, the supervisors should be such who would take active and consistent interest in workers.

43. Some characteristics of effective supervision in a Government Engineering Factory.

H. C. GANGULI and S. GOSWAMI, Kharagpur.

This paper is part of a study which was made in a government heavy engineering workshop and deals with the characteristics of good supervision both from the point of view of workers and the management. The "goodness" of a supervisor was determined worker-wise by the percentage of satisfied workers under him and management-wise by ratings of his superiors. Some of the important findings are stated below : (1) The *good supervisor,* rated as such by management as well as workers, does not identify himself primarily with the company as against the employees, which the poor supervisor does; he also tends to look at his job more in terms of employee needs and less in terms of production needs. (2) There seems to be a distinct relationship between *pride in work-group* and good supervisory behaviour. A good supervisor tends to look upon his group as more efficient and more well-behaved and less troublesome than other work groups in the same factory. (3) When judging the factory as a whole and the progress it has made and the satisfaction of its employees, the good supervisor tends to be more critical and less laudatory than his poorer colleagues. (4) Good supervisors and more particularly those rated high by management take a positive attitude toward trade unionism. (5) Supervision liked by the workers seems to be related to a greater feeling of participation and belongingness in management policies, etc., on the part of the supervisor. However the *effective* supervisor from the management's point of view does not always have a greater feeling of participation in managerial activities. (6) Finally, at a personal level, the job satisfaction of a good supervisor is less than of his poorer colleagues.

Subjects for the study were : Workers 140; Firstline Supervisor -13; Chargeman—10; Asst. Foreman—3; Foreman—1.

Much of the findings agree with similar studies done in the U.S.A. The study is being extended.

DEFICIENCY AND CRIMINAL PSYCHOLOGY

44. Opinion Survey on the Constancy of the Concept of Crime.

A. N. DEB, Allahabad.

The concept of crime has been modified from time to time as the civilisation progressed and understanding and insight into human nature grew wider and deeper.

Here is an attempt to find out which acts are considered *criminal* by the people, without taking into consideration the legal aspect of the act. This paper confines the investigation to mainly three items.

There is no definite view in the population as to whether an act against God should be considered as a crime. An act against social welfare is unequivocally considered as a crime. Though not emphasised as the previous one still people think that violation of law and order ought to be classed as a criminal act. The group does not give a positive verdict that an act directed against self is criminal, yet it goes all out to condemn the act of suicide as 'criminal'.

45. Preliminary study of personality difference of the criminals.

S. KUNDU and K. MUKHERJEE, Calcutta.

The subjects of this survey were the convicts recently admitted in the Alipore Central Jail, sentenced for more than one year.

Four individual tests of performance, Dearborn's Formboard, Alexander's Passalong, Koh's Block Design and Knox's Cube construction, constituting a battery were administered on fifty such convicts.

The entire number of cases were divided into two specified groups—offences committed 'Without Violence' and 'With Violence'. Average scores of the groups showed some difference which were proved significant by 't' test, in favour of the

'Without Violence' group in all the tests. The predictability of the constituent tests of the battery was found out. Formboard was the most predictable, while Block Design was the least of all.

It has become apparent from the consideration of our data, that criminal behaviour, is to some extent, a dependent of their performance variations.

46. The unconscious motives in delinquency : A case study.

N. N. CHATTERJEE, Calcutta.

For the origin of delinquent behaviour more emphasis is usually given on the external factors like lack of parental control at home, poverty, bad associations and abnormal social atmosphere, but internal factors are often overlooked. In this paper the analytical materials of a delinquent boy is presented who was brought up in a healthy social environment but manifested antisocial activities like stealing, destructiveness, truancy and wandering. His delinquent reactions were caused solely from the internal causes and it was revealed that he had fixation in the oral and oedipus phase of sexual development. His stealing tendency appeared from his inability to adjust his sibling rivalry, while his truancy and wandering habit appeared from the maladjusted oedipus conflict. His destructiveness was created from the phantsies of both oral and oedipal origin, in which aggression was adopted for overcoming frustration.

47. A Psychological Study of 150 Mentallly Deficients.

ONKARNATH GANGULY, Calcutta.

The present paper gives a glimpse of the problems of diognosis, nature, causation and treatment of mental deficiency. It is based upon the authors observation and statistical analysis of the data obtained by him from an Institution for Mentally handicapped in Calcutta.

The author shows that no two Intelligence tests give same M.A. So the problem of Inter-test variability should be carefully tackled with in diagnosis of mental deficiency. The physical defects, mainly speech, hearing, delayed milstone, inco-ordinated movements, etc. and personality disorders, such as, restlessness, temper tantrum, etc. are jumbled up in each individual ament and produces a complex dynamic behaviour pattern. In this study the author shows an unique technique of observation and recording behaviour sample of the aments which according to him is very important for Institutional management and treatment. The causes of mental deficiency according to this study are mainly (1) Encephalitic fever or other diseases at the prenatal or postnatal stage. (2) Mental deficiency, drug addiction and position *W.R.* in parent. (3) Faulty way of bringing up at home in early infancy. (4) Early traumatic experiences, etc.

Institutionalisation is the first step prior to any kind of scientific treatment. Prolonged training on psychological line and "pari passu" psychiatric treatment usually produce encouraging results.

SECTION OF ENGINEERING AND METALLURGY

President :—DR. M. DATTA, Ph.D., M.Sc Tech., M.I.E.E.

Abstracts

CIVIL ENGINEERING

1. Two and Three Dimensional Potential Problems in Flow through pervious foundations.

S. K. ROY, Poona.

For structures on permeable foundations, analytical, numerical and analogy methods have been used with varying emphasis over a wide series of problems, for the solution of two dimensional potential problems, the use of complex potential allows a large series of cases to be grouped in simple expressions, but for three dimensional problems, however, solutions in closed functional form exist only in a limited number of cases. The typical features of two and three dimensional picturisation of flow into a system of relief wells are considered here. The two dimensional case of a multiple lines of relief wells is considered in terms of corresponding complex potential field. The typical geometry of the potential surface is however, revealed only in the full three dimensional treatment with a corresponding elucidation of the nature of concentration towards the entry of the well system. The relative amount of flow picked up by the different lines of wells are also exemplified. The illustration is also given of the usefulness of approximate analysis of surface potentials in case of structures of permeable foundation, in terms of comparatively simple expressions which give a good insight into the potential distribution, within a practical accuracy often sufficient in designs of structure, leaving only details and important structures to be analysed in the full three dimensional treatment.

2. Test on Prestressed Steel Open Web Girder.

K. K. BANERJEE, Howrah

Test on Open Web Steel Girder composed of rolled steel sections and round bars and prestressed by High Tensile steel wires is reported here. Besides checking the validity of the theory of 'Prestressed Steel Structures' the test was also intended to study if prestressing improves the behaviour of a girder to interal buckling.

Dial gauges for horizontal and vertical deflections were used and many Philip's bonded type Electric Resistance Strain Gauges were fixed to the girder for strain observation, while the specimen was tested under four points in a loading frame.

It is noted that the test checks the theory very well and provides the following additional informations. 1. The elasticity of open web girder is appreciably influenced by the contribution to deflection of the web member. 2. Both increased area of compression flange and prestressing wires increase the lateral stability of the girder. 3. There is not much danger of the failure of tension flange so long as the prestressing wires are fixed to it. 4. Since it is possible that lateral buckling of the girder may be helped by early failure of the web members, strengthening of the web, as by additional members, should be helpful.

3. Manufacture of Bricks from Black Cotton Soil.

N. K. PATWARDHAN and N. C. MAJUMDAR, Roorkee.

account of the field trials conducted by this Institute [illegible] Indore and Bhopal. The technique consists of adding suitable proportions (20-30%) of pre-calcined B.C. Soil to the main bulk form which bricks are made. This new process was evolved in Building Materials Division of this Institute and the details of the laboratory investigation were reported in Indian Builder Vol. 5, (12), December, 1957. The field trials have been successful at both the places. The new brick, is stronger, less porous and has a better look. It also does away with dependance of the brick manufacture in these areas on the availability of coal ash which is very costly.

4. Determination of cement content by adsorption method.

S. C. LODH and N. CHOWDHURY, Jadavpur

For frequent checking of cement content in a sample of cement concrete and mortar at the site of work, by the usual chemical methods may not be practicable. After conducting a large number of experiments in the Laboratory, authors suggest in this paper to introduce Adsorption method for the rapid determination of cement content in cement concrete and mortar for field control purposes. The determination of cement content by this method is based upon the differential adsorption characteristics of cement and sand particles. Being chemically non-reactive with either cement or sand, $KMnO_4$ solution forms an ideal material for this experiment.

It is desirable to maintain a constant temperature in each determination. The procedure adopted is as follows. Ten to Fifteen c.c. of N/100 or N/200 $KMnO_4$ solution diluted with 50-100 c.c. of distilled water in a conical flask. A freshly mixed cement sand mixture passing 40 mesh was gradually added till the pink colour of the suspension disappeared and thoroughly shaken for 20 minutes with every addition of the mixture. The quantity of cement sand mixture required for decolourising the $KMnO_4$ solution was calculated from the difference of final and initial weights of the flask. The quantity of cement sand mixtures required for decolourising $KMnO_4$, varies with the composition of the mixture and decreases with increase in the concentration of cement. The experiment was tried with set cement sand mixture and no regular variations were noticed. It appears that this method is applicable for the rapid determination of cement content in freshly prepared cement sand mortar samples with reasonable accuracy.

ELECTRICAL ENGINEERING

5. A simple treatment of current loci based on simplified and Heyland's equivalent circuit of a three phase induction motor.

M. L. JAIN, D.Sc., Patiala.*

O : Synopsis.

The proofs of the current loci being circles and other derivations therefrom, are based on complex algebra. This method of treatment is simpler and more direct than the geometrical methods presented by other authors. The method is particularly useful in case of Heyland's diagram which becomes very cumbersome by ordinary methods. Due to its higher accuracy Heyland's diagram must have become more generally used, had there been simpler treatment available. It is hoped that the present paper will remove this difficulty and engineers will use Heyland's equivalent circuit with as much ease as simplified circuit and obtain much more accurate results.

6. Design of Transductors.

J. K. CHAUDHURY and S. K. GHOSE, Jadavpur University.

The transductor is a saturable-core reactor the impedance of which can be varied by the process of exiciting the core by a periodically varying magnetomotive force subjected on the 'gate' winding and by a unidirectional magnetomotive force applied on the 'control' winding—both forces being applied independently and simultaneously. The variation of the unidirectional m.m.f. changes the saturation angle of the core during each half cycle and thus its impedance varies. The transductor is primarily a power amplifier where a small change in control current can produce a larger change in the load current.

During the last decade considerable work has been done on transductors both in light current and heavy current engineering. Transductors have recently replaced many electronic circuits in typical applications *e.g.*, servomechanism, due to its distinct superiority. With transductors the authors have designed a conventional magnetic amplifier of about 0·45 watt output to operate a recording instrument. A second harmonic magnetic inverter has been designed to use it as a very sensitive input stage of an amplifier. In heavy current side a d.c. current transformer has been designed to record 250 amperes direct current on a moving coil instrument without using a shunt. A typical transductor control relay is made to have a trigger action due to a slight change in current in any circuit.

7. Lay-out Design of Meter Equipment.

R. N. GANGULY, Calcutta

The lay-out design of meter equipment for large consumers is generally dictated by the arrangement of Switchgear. This is the reason why many equipments become perforce complicated and expensive if all details of Switchgear lay-out are not considered at a sufficiently early stage. The paper discusses the best methods of metering taking example of modern switchgear arrangement in the common use.

The relative advantages and limitations of (a) Parallel current transformers summation, (b) Mechanical summation and (c) Impulse summation were discussed. The problems of summating KVARH for leading and lagging power factor and the use of power flow relay where power may flow in either direction were dealt with for correct registration of KVARH meter.

The problems of summating KVAH were referred. The high cost of obtaining the true total vectorial KVAH render it uneconomic. Hence the use of summating KVAH arithmetically by impulses to obtain simultaneous KVA demand was described though theoretically arithmetical summation of KVAH is inadmissible since these are complex quantities.

8. Three phase electronic Wattmeters for the measurement of low power.

S. S. BANERJEE and H. SARKAR, Banaras.

A three phase electronic wattmeter has been designed which is capable of measuring low as well as high power. The basic principle of three phase power measurement is almost the same as in the case of a single phase circuit as already published in one of our papers (J. Sci. Industr. Res., Vol. 16A, No. 4, p. 176, 1957). An alteration is, however, made in the arrangement for the shunt resistance in the instrument used for obtaining the voltage component in load circuit. As in the case of single phase electronic wattmeter, the current component of load is obtained from series resistances of low value connected to one of the lines and the voltage component from the shunt resistance of large value, one end of which is connected to this line and the other end is connected to the remaining two lines in turn by means of a two-way switch.

Balanced loads have been considered because single wattmeter method of three phase power measurement is possible only in the case of balanced circuits. As is usual, in the case of single wattmeter method of measuring three phase power the sum of the two measurements with the shunt resistance switched on to two different lines, as stated above, give the total power consumed in the load circuit. It is well-known that in a balanced three phase star connected load the three line currents are equal and the three phase voltages are also equal being symmetrically disposed and separated by 120°. Therefore, it should indicate the same meter reading when the instrument is connected to two different lines. But experimental results show slightly different readings when the shunt resistance used for obtaining the voltage component of load is connected to two different lines. This difference will be necessarily more pronounced when measuring small powers which, however, cannot be accurately measured with the electrodynamic type of wattmeter. The error due to this has been minimised by adding three shunt resistances of equal value incorporated in the instrument, which can be connected between the lines with the help of switches to maintain symmetry. They are operated by means of a ganged switch in order to obtain the voltage component of load from a particular shunt resistance. With this arrangement the instrument can measure sufficiently small power of the order of a few milliwatts with considerable accuracy.

9. The Mechanism of Dielectric Loss in Rosin and Ester gum.

A. K. SEN and G. N. BHATTACHARYA, Calcutta

A study of the dielectric properties of rosin and ester gum has been undertaken with a view to ascertaining the mechanism of dielectric loss in these materials. Both the resins show typical polar characteristics and in the temperature range of investigation they exhibit anomalous dispersion. With the help of melt viscosity data of these resins, the sizes of their rotating units have been calculated following Debye relations. The rosin rotating unit obtained from different relaxation times calculated from the temperature corresponding to the peak value of dielectric loss at a particular frequency gives a value of about 4·5 Å as its radius. This is in conformity with the dimensions of the abietic acid molecule as given by Ruzicka and his co-workers. The figure also agrees well with the experimentally determined value of the rotating unit of rosin obtained earlier by Kitchen and Müller. But the experimentally determined value of the radius of the ester gum rotating unit following the same method gives a much lower value. In fact, it gives exactly the dimension of a hydroxyl group, viz., 1·5 Å only. Since ester gum has a larger molecule than that of rosin—it being glycerol ester of rosin—it is postulated that the whole molecule of ester gum does not take part in the orientation process in the alternating field. It is suggested that the dimension of a hydroxyl group may be obtained from glyceryl mono- and di- abietates which are usually present in the commercial samples of ester gum. Any way, the mechanism of dielectric loss in the two resins is different, in the case of rosin the complete molecule takes part in the rotation while for ester gum a part of the molecule is only involved.

10. New methods of measuring impedance at microwave frequencies, using hybrid Tee.

C. S. KUMAR and R. PARSHAD, New Delhi.

New methods using hybrid Tee are developed for measuring impedances accurately. The data obtainable from the Tee-method is the same as for the usually employed moving-probe slotted-section, namely the standing-wave ratio and the shift of the minimum. The method depends upon the fact that when the arms 3 and 4 of the Tee are matched towards the junction, the power reaching the junction from the arms 1 and 2 divide in a way, that their vector difference reaches the arm 4 and the vector sum reaches the arm 3. Hence the power reaching the arm 4 is minimum when the waves reaching the junction from arms 1 and 2 have equal phase and this power is zero, when these waves have equal amplitude.

The method consists in putting the unknown impedance on arm 2, and an attenuator and a moving short in arm 1. Powers fed from arm 3 is detected in arm 4. The position of the moving short and the attenuation in arm 1 is adjusted till the power in arm 4 is zero. For finding the shift of the minimum, the impedance is replaced by a short and the shift of the moving short from the position for minimum power above to the position for minimum power when the short is used, is the shift required.

In the alternative method, there is no attenuation in arm 1, and the movable short is moved back and forth for getting minimum and maximum power in arm 4. The ratio of power yields the standing wave ratio. A variant of this method is the use of variable attenuator in arm 4. It is adjusted till the maximum power is attenuated enough for obtaining a constant power reaching the detecting crystal in arm 4. The methods give accurate results, avoiding the errors produced by a slotted section.

11. An improved method for determination of Q of cavity resonators.

C. S. KUMAR and R. PARSHAD, New Delhi

Two new methods of measurements of Q of microwave cavities, using hybrid Tee are described. The methods are more accurate than those using the slotted-section.

The first method is an analogue of that using the slotted-section, for a reflection type cavity. A chart relating standing wave ratio and frequency yields the Q. The increased accuracy of the present method is due to the greater accuracy available in the measurement of high standing wave ratios.

The second method is a spot-test method and hence much economical in time of observation. From the voltage standing wave ratio at resonance is computed that at half-power points. The parameters of the Tee-circuit are adjusted for this ratio and frequency of resonance adjusted to obtain a null in the E arm of the hybrid Tee.

Experimentally, the arm 1 has an attenuator and a movable short and the arm 2 the cavity under test. Power is fed from H arm and detected in the E arm. The microwave field reaching the junction from the cavity arm is matched in amplitude and phase by adjustments in arm 1, so that no power reaches the E arm. Knowledge of attenuation in arm 1 yields the standing wave ratio. In the present method, knowledge of the latter determines the former which is present for obtaining null at the half-power frequencies. Determination of latter yields Q.

12. Distortion Characteristics of Pulse-slope Modulation.

J. DAS, Kharagpur.

In an ideal P.S.M. system with infinite bandwidth, the demodulated signal is found to be distortionless. But the various circuits and the transmission medium used in practical cases are always bandwidthlimited. It is, therefore, of interest to determine the distortion obtained in circuits and media with different cut off rate. Theoretical analysis shows that distortion increases with the increase of the cutoff rate and the decrease of the cutoff frequency. With a simple peakdetector as the demodulator, the second harmonic distortion in the output is considerable. But with a 'Boxcar' pulse-lengthener as the demodulator, the gate pulse can be so arranged that the output is almost distortionless even with serious bandwidth limitation. Effect of the high frequency cutoff is more severe than that of the low frequency cutoff.

Experimental determination of distortion has been carried out with R-C filters giving 6 db/oct. cutoff rate and with variable cutoff Electronic filters giving 18 db/oct. and 36 db/oct. cutoff rate. Linearity of modulation and demodulation was found to be excellent for a volume range of 40 db. The average system distortion was only about 1·2% and the nominal bandwidth was 1 Mc/s. Distortion obtained with an R-C lowpass filter, with $RC = 2 \times 10^{-6}$ sec, was 15% for the peak detector and was only 1·8% for the 'Boxcar' pulse-lengthener. Distortion obtained with the Electronic filter with $f_c = 150$ Kc/s, was 15% for the peak detector and was only 3% for the 'Boxcar' pulse-lengthener. Distortion with lowfrequency cutoff was small even for severe limitations. 'Boxcar' pulse-lengthener circuit, thus, gives an improved demodulated output. For lowdistortion output, the cutoff rate of the transmission system should be in the range of 6 to 12 db per octave. Compared to the P.L.M. and P.P.M. systems, where distortion is approximately 5% for proper system bandwidth, the results obtained here for the P.S.M. system is more satisfactory.

13. Measurement of Night Time Collisional Frequency in the F_2 Region of the Ionosphere.

S. S. BANERJEE and S. K. SHARMA, Banaras.

The usual average reflection coefficient method of measuring the collisional frequency of electrons with neutral molecules in the ionosphere as originally developed by Appleton, is not suitable on many occasions during the night-time when the second echo continues to remain stronger than the first for fairly long time. During this period the absorption as well as the group-path of the wave in the ionosphere may undergo an appreciable change. It may be mentioned that while this anomaly in the separate magneto-ionic components is attributed to ionospheric undulations by Ratcliffe, Banerjee and Mehrotra and by Rawer, the anomally in the unsplit echoes is attributed to interference between the magneto-ionic components by Mitra.

The concept of ionospheric undulations or ripples mathematically treated by Rawer has been used in the present investigations for estimating the collisional frequency of electrons in the F_2 region of ionosphere during the night under the conditions of anomalous reflections. It has been found that the collisional frequency during the night varies between wide limits of 200 and 1000 collisions/sec. It may be mentioned that Ghosh found collisional frequency in the F_2 region at mid-night over Calcutta to be of the order of 100 collisions/sec. by the average amplitude method. It may be further mentioned that the presence of undulations in our observations has also been verified by calculating the horizontal velocity of the undulations which is found to vary from 5 to 35 metres/sec. and this is not far away from the values obtained by others.

14. Nonlinear theory of bridge stabilized R-C oscillator.

A. K. CHATTERJEE and N. SARKAR, Pilani.

A nonlinear theory of bridge stabilized Oscillator is described in this paper. The analysis is based on the fact that the amplitude characteristic of the amplifier portion of the circuit can be represented by a third degree polynomial. Solution of the nonlinear differential equation of the circuit yields the amplitude of oscillation and the condition for self excitation. Expressions for higher harmonics and the interrelation between frequency deviation and higher harmonics are discussed. Finally, a check with experimental results is shown.

15. An electronic counter for predetermined numbers.

V. K. ARORA and R. PARSHAD, New Delhi.

Coincidence technique developed earlier in this Laboratory has been used to obtain predetermined counting by use of decade scalers in cascade. Let the number to be counted be 56. Starting from the zero-state of the decades, it is clear that as 56 input-triggers are applied, to the first decade, the latter will record the count six, six times. By means of coincidence arrangement, an output trigger is obtained from the first counter at every count of six. The six such triggers (for every 56 input triggers), applied as input to the second decade, will record a count of six in the second decade. By means of coincidence, an output trigger is obtained at the count of six in the second decade, which resets both the decades to the zero-state, thus yielding the predetermined count of 56. The coincidence trigger at the second decade serves as an output trigger for the predetermined counting.

For a bigger number say 163, it is clear from the above that 3 decades have to be used, the first yielding an output trigger at count of 3, the second at count of 7 and the third at the count of 2.

MECHANICAL ENGINEERING

16. Vibration analysis of Shrouded Turbine Blades.

B. R. SINGH and N. S. NANDEESWARAIYA, Kharagpur.

The vibration of rotating turbine blades with shrouding rings and lacing wires is generally complex. The system may be excited by the impact of the rapidly pulsating gas forces as the blades and blade passages alternate around the edge of the stator; or by the circumferential and torsional vibrations of the rotor discs.

In this paper the natural frequencies of flexural vibration of shrouded turbine blades in the plane of the turbine disc and perpendicular to it have been analysed and obtained on the basis of rigidly jointed continuous framework. The results of the investigation have been presented in terms of nondimensional parameters in a graphical form.

17. Experimental investigation on stick-slip sliding—Part I. Steady Velocity Drive.

B. R. SINGH and H. B. MOHANTI, Kharagpur.

This paper presents an experimental investigation of critical velocity of stick-slip sliding of an elastic system driven at a uniform velocity under boundary friction. The influence of various dynamical parameters such as kinetic friction, damping, stiffness and mass of the elastic system on the critical velocity was studied on a mechanical model. The system was provided with rectilinear drive arranged on a milling machine. The arrangement was also simulated on an electric analogue computer so as to obtain a more accurate evaluation of the critical velocity of sliding. Good correlation was observed between the experimental results on the mechanical model, the analogue computer, and the theoretical values.

18. Experimental investigations on stick-slip sliding—Part II. Fluctuating Velocity-Drive and Forced Vibrations.

B. R. SINGH and H. B. MOHANTI, Kharagpur

It has been shown that the critical velocity of sliding of an elastic system driven with a fluctuating velocity under boundary friction is influenced by the frequency and the amplitude of the fluctuation. Again the critical velocity of the elastic system is also affected, if the sliding mass is subjected to forced vibration. This paper presents the results of investigations conducted on the critical velocity of an elastic system by simulating the foregoing arrangements on an electric analogue computer. From the results obtained it appears that the critical velocity is considerably increased when the frequency of fluctuations or that of impressed force resonates with the natural frequency of the elastic system. At higher frequency ratios, the fluctuating drive does not appear to influence the critical velocity although in the case of forced vibration it was observed that the critical velocity is considerably decreased. It is thus concluded that where stick-slip effects are to be eliminated, resonant vibration should be avoided, while high frequency forced vibration may be employed to advantage.

19. Ship Resistance.

S. C. CHAKRABORTY, Calcutta.

With the increase of speed until full speed is reached, a considerable portion of the energy developed is required to overcome the inertia of the mass in motion. When speed is constant no further power is required for accelaration and the whole power is absorbed in overcoming the resistance to motion. The resistance to the movement of a ship :—

(i) Wave making or form resistance energy required for the maintenance of the system of waves which surround and accompany the ship. Similar ships of different sizes at corresponding speed-length ratio is $\propto$ to the displacement. Speed-length ratio $= V/\sqrt{L}$; V = speed, knot; L = length, ft. Where $V/\sqrt{L}$, less than 1; the residual resistance is 10 to 25% of the total resistance.

(2) Eddy resistance—energy required for the maintenance of large eddies of water in vortex motion.

(3) Frictional or skin resistance—energy required for the maintenance of a belt or blanket of eddying water close to the surface of the ship :—$R = fAV^{1.83}$ lb.; A = wetted surface, sq. ft.; the constant f varies with the ship length. $A = L(Bb + 1{\cdot}7H)$ or $A = K\sqrt{DL}$, where K ranges from 15·0 to 16·0.

(4) Air resistance—roughly the end on resistance; $R = 0{\cdot}002B^2V_R^2$ lb. V_R = Ship speed relative to air in knots. It is usually less than 3% of the total resistance.

METALLURGY AND CHEMICAL ENGINEERING

20. Gravity concentration of a low grade Uranium Ore from Jadugoda, S. Bihar.

J. Y. SOMNAY, Bombay.

Beneficiation studies for uranium were carried out on a low grade ore from Jadugoda, South Bihar, assaying 0·052% U_3O_8. The ore is from a quartz-chlorite schist rock and the major portion of radioactivity is due to primary uranium minerals which occur as fine disseminated grains.

Various feeds for Wilfley table were prepared by stage grinding the ore to different mesh. Tabling of properly sized fractions indicated that overall increase in the recovery of uranium in concentrates is effected with finer feeds. However, there is a gradual fall in the enrichment ratio. It was observed that a concentrate assaying about 0·1% U_3O_8 was obtained at an overall uranium recovery of about 77%.

21. Production of high-grade Manganese Dioxide concentrates from low grade Ores of Shimoga Distt. of Mysore State.

V. A. ALTEKAR, P. P. MIDHA and S K AWATRAMANI, Bombay.

The problem of the utilisation of low grade manganese ores and waste dumps is vital not only from the mineral conservancy point of view, but more often, as this paper describes, it may turn out to be a highly remunerative one. During a visit to the manganese mining area of the Shimoga district of Mysore, a critical examination of the waste dumps and low grade deposits revealed a large variety of manganiferrous minerals having diverse physical properties and associated with several combinations of gangue matter. It was at once clear that the beneficiation of these samples (even from a single mine) could not be possible with a single simple flow-sheet. The complexity of the problem could be gauged by the following examples: High manganese samples (46% Mn) showed an unsteady sp. gr. range from less than 1 to more than 4·01, some were high silica (55% SiO_2) deposits, some were high iron deposits (15% Fe), some were dense and hard and some were friable, some were finely mineralised, others were coarsely crystallised.

The samples were catalogued, and some of the promising ones were subjected to the simple separatory processes in the Ore Dressing laboratory of the Bombay University. The paper describes some of the investigations which have resulted in the production of high grade (58% Mn.) manganese concentrates (+20 mesh) from low grade waste ores containing 20-25% Mn. The work includes mineralogical and ore-microscopic studies, heavy-liquid sink-float tests and establishment of the relationships between manganese content and specific gravities, liberation studies, Tests with laboratory and pilot plant jigs, tables, classifiers and magnetic separators etc.

It was possible to obtain two high grade concentrates by jigging of 8 mesh size. The first assaying 54% Mn. and with 15% recovery and second assaying 52% Mn. and with 65% recovery or a single 52·8% Mn. concentrate with overall 80% recovery. At finer sizes tabling followed by magnetic separation gave 57% Mn. concentrates which on ignition assayed 59% Mn. The concentrates assayed over 90% MnO_2 less than 2·0% Fe, 1·5% SiO_2, 0·01% P. The scheme which was financed by Messrs. Nakimpex Traders of Bombay has resulted in the successful establishment of a commercial dressing plant.

22. Separation of Antimony from Lead Antimonate.

S. V. SURYANARAYANA and H. N. DAS GUPTA, Dhanbad.

The work-lead has to be softened in order to render it suitable for desilverisation processes. Towards the end of the softening process antimony appears on the surface of lead as oily drops of lead antimonate, which is skimmed off with the aid of lime or ashes. It is a fact that the separation of antimony from lead antimonate cannot be easily effected. Out of theoretical interest, attempts have been made to isolate antimony from the lead antimonate, which were procured from a lead smelting works. Results of the preliminary examinations go to show that it is quite feasible to isolate antimony after subjecting the antimonate to chloridising roasting. Solvents methods have also been experimented with and the results are quite encouraging.

23. Beneficiation of Ferruginous overburden from Iron ore deposits from Southern Coastal Region of Bombay.

V. V. ALTEKAR, Bombay

Samples of ferruginous lateritic overburden containing about 40% iron from the Sawantwadi region of southern Bombay was subjected to tests with a view to making exportable concentrates. The iron being represented by limonite finely admixed with clays, silica and other gangue matter, neither high grade (57% Fe) nor high recoveries were possible with gravity and magnetic processes. The results are in accordance with similar tests reported by others working on laterites of other regions

24. Beneficiation of Sittampundi Felspar.

K. KHALEELUDDIN, A. V. RAJESWARA RAO and
D. S. DATAR, Hyderabad-Dn.

The anorthite felspar from Sittampundi, Salem District, was used in the preparation of white cement. The felspar is white in colour with several black coloured occlusions. The black particles are non-magnetic, containing mainly iron and manganese, which are partly in the form of carbonates. Some improvement in the quality of the felspar is observed when it is calcined under reducing atmosphere at 400°C or with ammonium or calcium chlorides.

The black particles are completely separated by heavy liquid separation method using Bromoform (density 2·86). Experiments on X-ray and chemical analysis of the black particles are in progress.

25. Beneficiation of Indian Graphite by High-tension separation.

K. K. MAJUMDAR, Dhanbad.

Flaky graphite of crucible grade from Sambalpur and Patna State (Orissa) were subjected to high-tension separation in a Carpco Laboratory Model High-tension separator with a view to upgrading the Carbon content of the minerals. A corona-electrode type of field at a voltage of 8,000 and with positive polarity of the electrode were used. The speed of the roll (dia 6 inches) was maintained constant at 74 r.p.m. The temp of feed was 110-115°C. Of the three varieties tested only one sample from Patna State No. B responded fairly well. 'Carbon content increased from 76·79% to 85·29% with a recovery of 61·30%

26. Studies on the behaviour of Graphite in an electrostatic and high-tension separator.

K. K. MAJUMDAR, Dhanbad.

Flaky graphite (ash 3·78%, −20+35 mesh) was subjected to separation in a Carpco Laboratory Model High-tension Separator. Three types of field were used depending upon the position of the electrode : (a) electrostatic, (b) corona-emission and (c) corona-electrode. The polarity of the electrode and the speed of the grounded roll was also varied. The feed was heated to 110-115°C. It was found that the best separation was effected by employing corona-electrode type of field with positive polarity of the electrode. The lower speed of roll (74 rpm for 6 inch dia roll) gave better results than higher speed (198 rpm). About 80% of the feed was separated as conducting fraction under the above conditions at a voltage of 8,000 (maximum possible under the condition of the experiment) at a single pass.

27. Wet Assay of Silver in Base Bullion and in Galena.

S. V. SURYANARAYANA, A. K. BOSE and H. N. DAS GUPTA, Dhanbad.

Silver may be determined as the metal itself in ores or in bearing materials by the adoption of dry assay procedures. Modifications in respect of actual procedure are ,however, necessary when the silver bearing materials are of complex type and, as such, they present more difficulties to the assayer. The end of the cupellation operation may be ruined by "spitting" or "sprouting" of the silver button. If stibnite happens to be present in the original material, the cupellation results are found to be indifferent. It is thus evident that by dry assay method a correct measure of the amount of silver in ores may not always be found feasible.

A few assayers consider the wet way of estimation of silver in ores as wholly unsuitable. The present communication, however, deals with the epitome of a simple modified volumetric method for the estimation of silver in base bullion and in galena. The process consists in precipitating silver with potassium iodide in presence of hydrogen peroxide and starch solution. The end point is indicated by the formation of the blue colour dre to starch and iodine when the last trace of silver has been precipitated. The lead bullion, in the form of fine drillings, or finely powdered galena is required to be dissolved in pure dilute nitric acid and the lead is precipitated as sulphate by treatment with sulphuric acid in the usual way. The filtrate from this is titrated with N/100 potassium iodide solution as outlined above. The process has been standardised with a stock solution of assay silver to which additions of copper (in small quantity), Lead, Zinc, dil nitric acid, dil sulphuric acid and oxalic acid have been made. A preliminary note on this process appears in the July issue of the Indian Chemical Society, 1958. The results obtained by the present method have been found to be identical with those obtained by the adoption of gravimetric method. Further works aiming at studying the suitability of this method to ores of silver or to copper matter is in progress.

28. Studies with a semi-continuous laboratory size heavy media separator.

V. A. ALTEKAR and K. VASUDEVA, Bombay.

A 30 cm. diameter cone type heavy media separator, which was designed and constructed by the senior author for exhibition purposes, was found to be very suitable for semicontinuous testing operations. The performance of this unit was rigorously tested by using different media for separation of various specific gravity minerals. The paper describes the performance of the unit when employed for preconcentration of the pyritic portions from coal-washery rejects. A wide size range of feed comprising of 1·5 sinks from a coal washery, and containing 3% pyritic sulphur, was subjected to the heavy liquid separation using organic liquid mixes at several densities above 1·6 sp. gr. It was noted that at 1·7 sp. gr. cut a sink product was obtained which was only 30 per cent by weight of original feed but contained 95% of the sulphur. This separatory behaviour was shared by several size ranges below -⅝" size. Subsequently the cone separator using barites medium at 1·7 sp. gr. was substituted for the static sink and float test. The feed ranged in size from -¾" to 10 mesh. The performance was tested over wide range of conditions of rates of feed, fluid velocities, viscosities ets. Evaluation of the performance in the form of the Tromp Distribution curve on a standard graph rates is in the excellent category It is observed that there are no light particles in the heavy fraction although a few heavy density particles are to be found in the light fraction. This is attributable to the wide range of size and to the higher velocities of the medium used. It is also found that Heavy media separation is ideal as a preconcentration step in the recovery of pyrites from coal rejects.

29. Investigations on Colorimetric Method of Metallurgical Analysis—Part VII. Further work on the rapid estimation of Silicon in Steel.

G. V. L. N. MURTY and T. R. RAMASWAMI, Jamshedpur.

A modified procedure has been developed for the estimation of less than 0·1% of Silicon in Steel. Alterations in the composition of solvent mixture and the concentration of the reducing agent have been effected to eliminate the premature reduction of the Molybdate complex by ferrous sulphate and to ensure the formation of a stable blue colour.

30. Oxidation of Bituminous Coals—Part I.

J N. CHAKRABARTI, Dhanbad.

The effects of oxidation and size reduction on the swelling properties of various size fractions of coking coals (XIII and XIV Seams, Jharia) at different temperatures have been investigated. The swelling properties of the coals were determined in accordance with the standard B S. crucible swelling test and the oxidation was done in air. It was found that the swelling number increased for the coals when they were more finely ground. It was also found that the swelling number decreased as the period of oxidation was increased, but the change appeared only after several hours of oxidation.

31. Roasting of Zinc concentrates obtained from Zawar Ore.

V. A. ALTEKAR, Bombay.

While ascertaining the suitability of the zinc concentrates obtained from the Zawar ore for electrolytic production of zinc, experiments were conducted on the concentrates to study its behaviour under various conditions of roasting. The paper describes the experiments on roasting of the concentrates obtained by differential froth flotation of the ore. The roasting was carried out at fixed temperatures in the range of 500 C- 750 C and the data obtained indicate that the concentrate can be conveniently roasted with good control over the physical and chemical properties of the clacines. The rate of formation of water soluble sulphate, the same of zinc-oxide, the same of zinc ferrite were studied, at various temperatures.

32. The optimum size of lump charge in a blast furnace.

B. I. KITAYEV, Bombay, A. N. TCHERNIATIN, and H. N. SINHA, Bombay.

The optimum size of the lump charge in a blast furnace effects to a large extent the rate of reduction processes and hence its operation. The rates of heat and mass transfer which increase with the velocity of gas flow are dependent upon the size of the lump and increase with the decrease in size of the lump charge. But the admissible velocity of the gas flow is determined by the aerodynamic resistance of the charge and it increases with increase in size of the lumps.

From above it is evident that conditions requiring both an increase and decrease in size of the lump charge exist for an efficient operation of a blast furnace. The different aspects (conditions of charge for standard blast furnace process, development of low shaft furnaces, etc.) indicate that the time has come to establish a relationship between the size of lump charge, shaft height, pressure drop and output efficiency with the help of the laws of main processes taking place in a blast furnace. Thus a relationship has been obtained with the help of modern experimental data and is given in the form of an equation in the paper. The derived equation shows that a simple relationship must exist between the variables affecting the blast furnace operation.

Similar result was obtained when the conditions of the calculations were confined only, for example, to the usual (Hot metal) operation of a blast furnace. The calculations show that the useful height in this case is approximately 200 diameters of the average size of the lumps for an output of 2·2 tons/m^2/hr. and approximately 150 diameters for 1·1 tons/m^2/hr.

33. Studies on Manganese Dioxide.

S. S. MANELKAR, N. R. KAMATH and B. N Ghosh, Bombay.

Manganese dioxide has been prepared from aqueous solutions of manganous salts under various conditions and the electrode potential for the cell system

$$\mathrm{Pt\text{-}MnO_2/MnCl_2.HCl/AgCl.Ag}$$

determined. Since manganese dioxide is used as a depolarizer its effect on the pH and potential is being studied at length. The effect of conditions of preparation on the electrode potential of manganese dioxide has been discussed.

34. Titanium Addition Modifies Properties of α-brass.

S. K. BISWAS and S. C. DAS GUPTA, Howrah.

Effects of varying amounts of titanium (viz. 0·08%, 0·24%, 0·46%, 0·68% and 1·22%) on different properties of alpha-brass (70 :30) were studied. Results indicated improvement in hardness and tensile strength with tolerable deterioration inductility. Corrosion resistance in various media viz. Sea-water, 10% Sulphuric acid and 15% Caustic Soda was better in all cases than titanium free brass. Oxidation resistance at elevated temperatures improved up to 350°C but deteriorated above this temperature. Study of grain growth characteristics indicated that titanium inhibits grain growth in all cases and very markedly in case of 1·22% titanium alloy.

35. Heat Transfer to liquids in packed beds.

S. K. MUKHERJEE and A. S. BHADURI,* Calcutta.

Coefficients of heat transfer to a liquid flowing through a tube packed with spherical glass balls were determined experimentally. Five different size balls were used. The ratio of the packing to the tube diameter (Dp/Dt) has been found to be the controlling factor in the heat transfer phenomenon. The co-efficients vary with the mass velocity raised to 0·45 power and with a function of the ratio of the particle diameter to the container.

36. Underground Corrosion of Metals and Alloys.

B. CHATTERJEE, Sibpur.

In continuation of our work on the underground corrosion of metals and alloys, the corrosion of a sample of brass (Cu, 65·80%; Zn, 33-43% and Sn, 0·77%) in Sibpur soil has been studied by measuring the combined weight losses of corrosion cell electrodes made of this material after exposure to this soil for twelve months in an atmosphere saturated with water vapour. The effect of the addition of a small amount of titanium to the sample of brass on the underground corroson has also been studied. The corrosion of brass under these conditions has been found to be much less compared to that of mild steel (0·0047 gm. against 0·064 gm. per cc.). The addition of 0·2 per cent titanium has been found to improve the resistance of the brass sample to underground corrosion in this soil by 6·4 per cent.

37. Studies on individual film resistances in mass transfer in wetted-wall extraction towers.

M. RAJA RAO, Bombay and C. VENKATA RAO, Waltair.

With a view to studying the relative influences of the phase velocities on individual film resistances in mass transfer, investigations on the extraction of acetone between water and toluene have been carried out in a 1·6″ inside diameter, and 42″ long wetted-wall tower using aqueous phase as the wall liquid and the solvent (toluene) phase as core liquid. The wave motion observed in the wall liquid was found to be strongly influenced by the wall liquid rate and the tower height. Further it was found that there was a tendency for the non-wetted patches to appear at a few places on the tube surface, especially at hgher core liquid rates.

In view of the difficulties in the precise estmation of the interfacial area, a, because of the prevailing wave motion and of the presence of non-wetted patches at a few points on the tube surface, it was observed desirable to express the extraction data in terms of the volumetric mass transfer co-efficients as Ka, instead of as area mass transfer co-efficients as K.

The efficiency of mass transfer, expressed as overall extraction co-efficients, was observed to be only 15 per cent higher in extracting acetone from water film to toluene core as compared with that in the reverse direction. The overall extraction co-efficients were first fitted as a preliminary correlation by the following relationships :--

$$K_T a = 0{\cdot}098 \quad L_W^{0\cdot54} \quad L_T^{0\cdot47} \qquad \text{(T to W)}$$

$$K_T a = 0{\cdot}082 \quad L_W^{0\cdot56} \quad L_T^{0\cdot56} \qquad \text{(W to T)}$$

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In order to resolve the overall coefficients into the film values and thereby establish the effect of the phase flow velocities on the individual film resistances, the results were examined by the graphical procedure of Brinsmade and Bliss. It was inferred that with this particular system and the apparatus used, each film resistance was not affected to any significant degree by the flow rate of the other phase. The final form of the equation deduced, related the overall and individual film resistance as follows :

$$\frac{1}{K_T{}^{d}} = \frac{0{\cdot}710}{L_T{}^{0{\cdot}64}} + \frac{7{\cdot}7}{L_W}$$

This equation permitted calculation of the overall extraction coefficients for any given set of flow rates and it was found that there is close agreement within 10 per cent between the experimental and calculated values.

38. Determination of activity of a catalyst in a flow reactor.

C. VENKATESWARLU and M. NARASINGA RAO, Sindri.

In the case of solid catalysed gaseous reactions it is often necessary to select the best grade of catalyst out of different commercial grades available. This is done by allowing them to catalyse a reaction under identical conditions—like temperature pressure, total feed and its composition and comparing the catalyst to feed ratios for a particular run. In this paper catalyst activity of five commercial grades of silica gel are compared by allowing them to catalyse vapor-phase esterification of ethyl alcohol with acetic acid in a four stage integral reactor.

39. A study of the influence of grain size and different thermal treatments on the fatigue behaviour of mild steel.

A. K. SEAL, S. DAS GUPTA and M. DAS GUPTA, Howrah.

The fatigue behaviour of a commercial mild steel containing 0·37 per cent carbon was studied after furnace cooling, air-cooling and oil quenching from different austenitising temperatures after a soaking period of one hour in each case. It was found that an increase in grain size of the specimens resulted in poorer fatigue properties. However, this relationship was not linear in nature.

Fatigue strength was found to be directly proportional to the tensile strength and in this case also the relationship was not linear. Oil quenched specimens showed the best fatigue property and the furnace cooled ones the poorest.

The mechanism of crack propagation was studied metallographically. It was revealed that the crack originated at the surface and then propagated inside leading to fracture, which is in line with the current views. The workhardening effect has also been studied along the length of the fractured specimens, furnace cooled from different austenitising temperatures, after a soaking time of one hour at the temperatures.

40. Viscometric Behaviour of Boric acid Mannitol Complexes.

L. V. NABAR and B N. GHOSH, Bombay

The interaction between boric acid and mannitol has been studied viscometrically at 30°C under varying concentrations. The results thus obtained suggest that the value for the constant of this reaction is 0·5 obtained by employing a modified form, as proposed by Macpherson and Percival, of Einstein's equation on the viscosity of solutions.

41. Studies on Ionic Hydration.

S. D. SULE and B. N. GHOSH, Bombay.

It is apparent from a survey of the literature that the concept of hydration number is not very well defined and that the hydration numbers obtained by various methods are not in agreement with one another. Since the concept of ionic hydration in solution is of great importance in order to account for the individual properties of dissolved ions, it is necessary to reinvestigate critically the various methods available for the determination of hydration number.

It is suggested that the magnetic susceptibility measurements of salts in solution under varying concentrations might yield a better average value for the hydration number of ions in solution.

The work in this direction is being conducted in this laboratory.

42. Preparation of Standard Pyrometric Cones—Part I. Cones Nos. 05 to 1.

MIR NOMAN KHAN, M. A. WAHAB and D. S. DATAR.

The present requirement of standard pyrometric cones is met mostly by imports and little work has been done in India for their production and standardisation By the end of the Second Five Year Plan period the consumption of cones is expected to be about 60 lakhs. It is believed that the cones if manufactured in the country and supplied to the industry at a reasonable cost will find great use and will also help the industry in improving their products and reducing the rejects. This paper describes development of suitable compositions for making pyrometric cones (Nos. 05 to 1) conforming to both the English and American standards.

43. Studies on some Inorganic Polymers.

M. M. DONDE and B. N. GHOSH, Bombay.

Some studies on inorganic polymers containing phosphorus, nitrogen and chlorine atoms have been made. The polymerised product containing these atoms is a rubber-like material and has been obtained by heating the lower polymers in sealed tubes for about six hours at aout 300°C. Transparent thermoplastic resinous substances have been obtained by the interaction of phosphonitrilic chloride-trimer with various organic compounds. Physical properties and practical utility of these are being investigated.

GENERAL ENGINEERING

44. Productivity pattern for Indian Industry.

RAMA G. KAMAT, Delhi.

Productivity move has received recognition from the Indian Government and it is going to be popularised with the help of U.S.A.

The idea is splendid, but it cannot be copied. It has to be adapted to the conditions in India which are completely different from those prevailing in North

America. Blindly following the American pattern, will drive us to certain disaster, instead of helping us achieve the desired economic progress.

The purpose of the paper is to give the proper meaning that productivity must have under the present conditions of economic development in India.

Productivity must be measured, accounting all the elements of input, such as direct and indirect labour, and the labour represented by the services, machines, fuel, power, raw materials.

But that is not sufficient.

From the National point of view, sometimes, highest productivity is not desirable. India has little Capital and an enormous labour force which increases more rapidly than production. This is a fundamental fact that cannot be forgotten.

As long as there are millions unemployed and the machines are not fully manufactured in India from indigenous materials, productivity must not aim replacing men by machines, but concentrate all efforts in the substitution of foreign materials by indigenous ones, and proper utilisation of all materials including fuel. The productivity can also be raised by full use of the installed capacity and better utilisation of the labour.

Last but not the least, is the need of efficient management by Engineers with the experience of the industry and training in the disciplines of scientific management. Without the control of the industry in the hands of duly trained men, there can b no proper productivity move.

45. Production Experiments to meet Destructive Test on a Finished Product.

C. K. HALDAR, Poona

While establishing manufacture of a new fuze for a shell, a bottleneck in production arose because a destructive test stipulated for a small slotted cone could not be satisfied. As the item formed part of a safety device this test was a critical one. Some standardisation was effected in a preliminary survey of the processes. A series of experiments were designed to reduce the estimated standard deviation of the collapsing load of the cone to less than 8 lb. and also to bring the average strength as near as possible to the mid-tolerance value. The optimum heat treatment between several draws of the brass strip and the most suitable method of acid cleaning of the finished product were established. An acceptance sampling procedure was also evolved.

The paper concludes that there is many a trouble spot in the production process which sticks out like a 'sore thumb' and is immediately recognised and removed. A systematic study of manufacturing operations by means of production experiments becomes inescapable for identifying causes which are not so obvious. Sufficient information can be quickly collected at a small cost to make substantial improvements to avoid a hold-up in the assembly line.

46. Industrial expansion in India during the Plan periods.

J. N. BASU, Calcutta.

The outlay during the first and second 5-year plans for industrial expansion is given in the following table. The capital investment Rs. 1,094·3 crores both in private and public sectors during the second plan period is 3·35 times that of Rs. 327 crores during the first Plan and is 15·2% of the total outlay of Rs. 7,200 crores in the second plan

India being a country of high-population-density, industry is of utmost importance for her very existence. So the measures suggested in the 2nd Plan is right one in the right direction. It may not be possible to arrive at the targets due to various difficulties specially of foreign exchange and food scarcity; though it is evident that in certain items, such as bicycles, radio-receivers, glass, soda ash etc., the targets will be exceeded.

During the first plan the production index of different industries are stated below; in engineering industries the figure of 240·1 is very welcome.

	Name of Industry	Index of Production in 1957. Base 1951—100
1.	Cotton textiles	115·6
2.	Jute textiles	120 5
3.	Cement	175·3
4.	Iron and Steel	119·3
5.	Sugar	185·4
6.	Paper	159 3
7.	Engineering Industries	240·1
8.	General Index	137·1

Due to the increased production in engineering industries India has been able to strike at the traditional disgrace of her inability to produce any machine, thereby, she met a portion of her requirement of machines and equipments and was further able to export her engineering goods in the foreign market. This enhanced her prestige of industrial capacity and to a great extent that of her engineers also. I hope and trust that her engineers will be conscious of this and will prove worthy of it.

TABLE I.

Item	Estimate under first plan	Investment actually occurred	Outlay during 2nd plan	Remarks
		Rs. crores.		
1	2	3	4	5
1. Metallurgical Industries Iron, Steel, Aluminium etc.	85 0	61·0	502·5	
2. Petrol refining	64·0	45·0	10·0	
3. Chemical Industries (heavy chemical and fertilisers, etc.)	26 0	27·0	132·0	
4. Engineering Industries (heavy and light)	53·0	46·0	150·0	
5. Cotton textiles	9 0	20·0	36·3	
6. Sugar Industries	0·1	5·0	51·0	
7. Rayon textiles (including staple fibre etc.)	16 5	8·0	24·0	
8 Cement	17·7	17·5	93·0	
9. Paper and paper board including news print	7·4	12·0	54·0	
10. Others	48·3	50·15	41·5	
TOTAL	327·0	293·0	1094·3	

47. Role of Statistics in Engineering.

A. P. BHATTACHARYA, Roorkee.

The potentialities of the applications of statistical methods in engineering problems have been indicated and it has been pointed out how new vistas open out in the field of engineering research by such applications.

Statistics has been defined as the scientific collection and analysis of data, and the projection of estimates. The statistical method is an economical procedure for getting at the facts and determining their significance with confidence. The scope of the collection of data and their statistical analysis have been elucidated. The importance of statistical concepts has also been explained in this connection.

The special field of engineering from which examples have been quoted for the above belongs mostly to Hydrology, in which the technique of statistical application has made rapid strides particularly in the United States of America. Some of these are rainfall, stage discharge relationship, water consumptive use, ground water resources, flood frequencies, etc.

48. Launching of Heavy Satellites.

B. M. BANERJEE, Calcutta.

Conventionally, rockets are launched vertically. While this attitude offers various advantages, it requires a motor thrust of about twice the rocket's starting weight. Artificial Satellites utilize multistep rockets to obtain the required 8 km./sec. velocity. Calculations indicate that the first step rocket should have thrust of 400 tons, for a satellite mass of one ton. And construction of motors of 400 tons thrust is an engineering problem of staggering dimensions.

Launching as a Rocket plane, accelerating horizontally on the runaway of an aerodrome, offers a solution. A Rocket plane of 70 metres wing span, powered by three 40 ton motors, can lift a total mass of 300 tons at a velocity of 350 m.p.h. After take off, such a craft may climb and accelerate continuously. This is possible because the thrust of rocket motors do not diminish with altitude, and the air drug can be kept the smaller fraction of the thrust by suitably programming the flight, in spite of the continuous increase in velocity, because the gain in altitude reduces air density. Accelerating in this manner, the craft would discard its wings when fuel consumption reduces its weight below that of the motor thrust. Before discarding, it would however utilize them to change the direction of velocity as much towards vertical as possible. At this point, it would have an altitude of 25 kms. and a velocity of 800 metres/sec. The vertical component of velocity, would allow a subsequent direction of acceleration only some 10° to 20° upwards of horizontal. This minimizes the "gravity loss" term. Calculation assuming rocket exhaust velocities of 2·4 kms./sec. in the initial stage and 2·3 kms./sec. in the final stage show that a mass of more than one ton could be placed in the orbit.